

SCIENTIFIC AMERICAN

No. 122 SUPPLEMENT

Scientific American Supplement, Vol. V, No. 122.
Scientific American, established 1845.

NEW YORK, MAY 4, 1878.

Scientific American Supplement, \$5 a year.
Scientific American and Supplement, \$7 a year.

THE NEW YORK ELEVATED RAILROAD.

It is quite interesting to study the variety of tools and machinery brought forward by the different companies engaged in the construction of the new elevated railroads in New York city. The Passaic Rolling Mill Company having contracted for about four miles of single track, thought it advisable to design new machinery especially adapted for the purpose. The points aimed at were safety and economy of erection, and, above all, rapidity and the reduction of the unavoidable obstruction to the ordinary street traffic to a minimum. The following description and a visit at the site of erection will suffice to show that they have succeeded admirably in their task:

The derrick for raising the columns is mounted upon a heavy truck drawn by two horses. The hind axle is bent so as to come within one foot of the ground, and supports the derrick proper. The latter is forked at the top, forming a letter M. To each joint is attached a tackle, worked by independent gearing. The blocks are attached to the column to be erected a little above its center of gravity. In raising the top of the column, it passes between and above the two prongs, and by this arrangement a 30 feet column is raised by a derrick 19 feet high. The average time required for raising has been 10 minutes to a column.

The machine for hoisting the girders is represented and explained by our engraving. The arrangement consists of two trucks, the first one carrying the iron hoisting frame proper and the second the hoisting engine. The two are coupled together and move with flanged wheels upon the girder previously placed in position. The forward point of the machine reaches to about the center of the span to be erected; the rear end is anchored to the girders upon which the apparatus rests. The hoisting rope passes over the drum of the hoisting engine. The average time of raising and placing one span is 15 minutes. When the two girders are fastened, a rope is attached to the column ahead and wound around the drum, whereby the apparatus is moved to its new

position. The company has raised with this machine 210 tons of iron per day.

The machine used in Front street is similar in design to the one described, but larger, 108 ft. long, with a reach of 50 feet. And it raises not only the longitudinal but also the transverse girders, some of which weigh upward of six tons.

All the machines were designed by Mr. Watts Cooke, the President of the company.

The engine as well as the frame is mounted upon the same truck, thus simplifying the arrangement. The rollers have no flanges, but are adjustable, so as to suit any distance between the girders from 8 to about 20 feet.—*Railroad Gazette.*

RAILWAY BRAKES.

A PAPER on "Railway Brakes" was lately read before the Civil and Mechanical Engineers' Society, London, by Mr. Edward Perrett. A description of the principles involved and of the construction of the various brakes was given, illustrated by numerous diagrams. The author, although acknowledging the superior promptness in action of the Westinghouse automatic brake, gave the preference to the steel McJames brake, as possessing a much greater simplicity of construction. The Smith vacuum brake was commended for its simplicity, but the author pointed out that as it had no reservoir of power under each carriage it could not hope to compete with the others, although many of the railway companies would probably prefer it to other more complicated but at the same time more efficient arrangements.

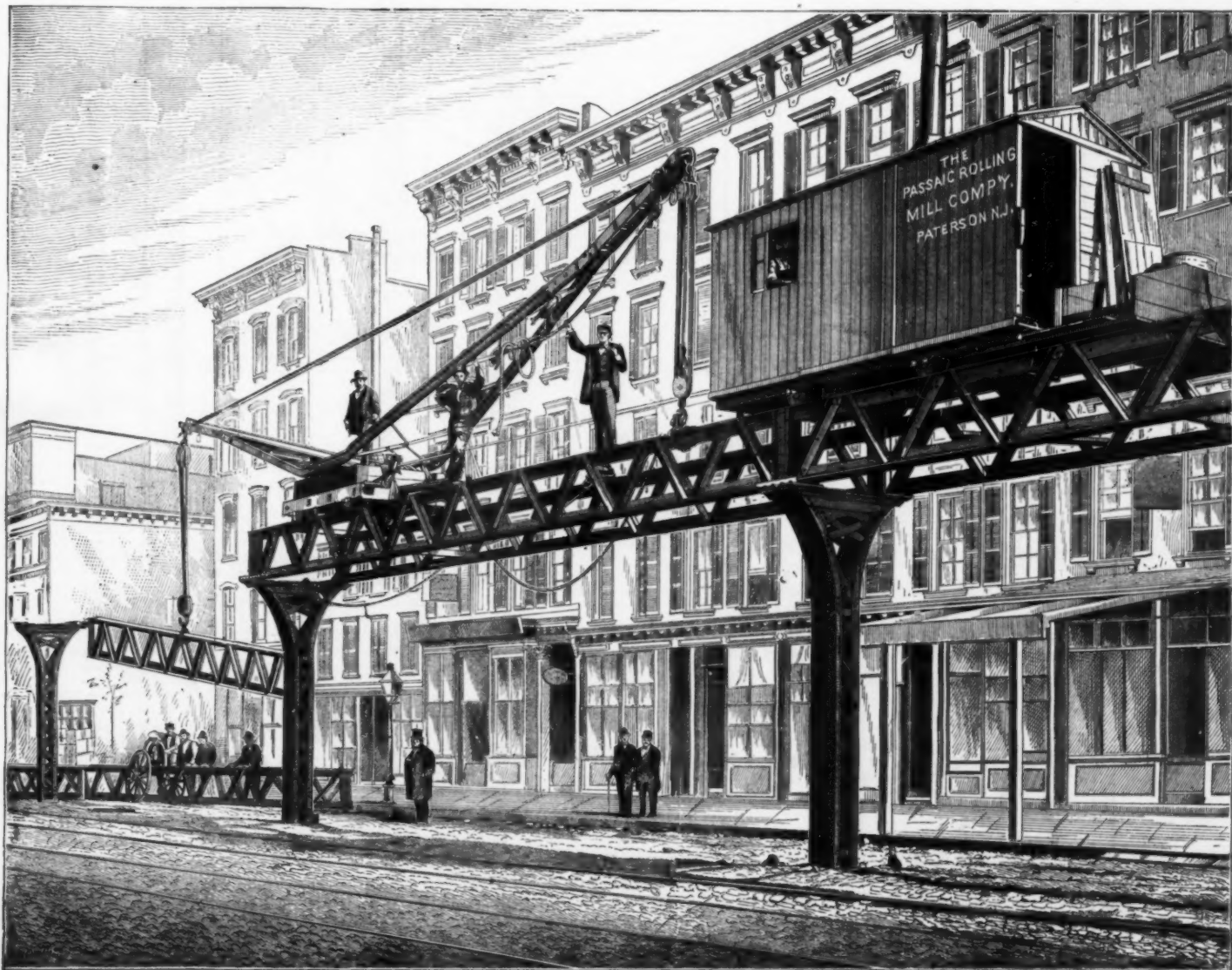
STEAM STREET CARS.

In Philadelphia the experiment of using steam street cars on the Market Street line was fully tried last year and for the time being approved, but has lately been abandoned owing to the expense of running such cars and the in-

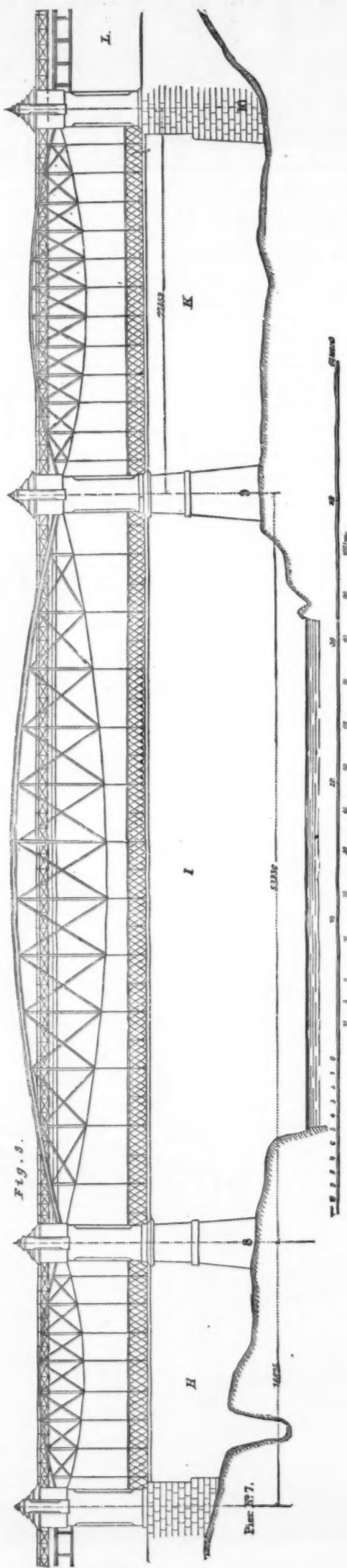
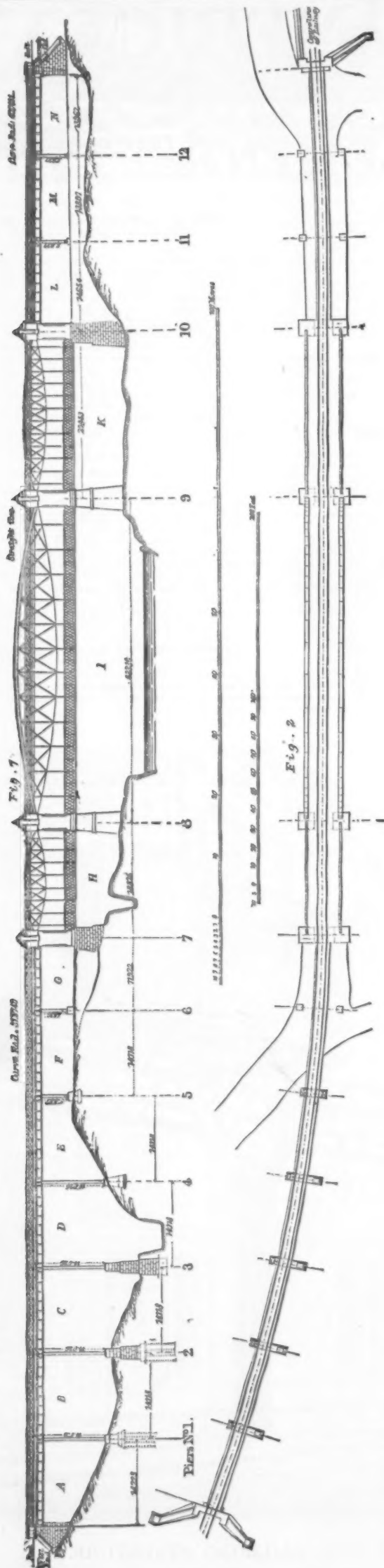
jury occasioned to the tracks, but on the Continent the adoption of steam tramway engines instead of horses is becoming very general. Rouen, Cassell, Barcelona, Bilbao, Lisbon, Oporto, the Hague, and other important towns are all following the example set by Paris, which has working in its streets engines which are noiseless, smokeless, and free from any objectionable features calculated to obstruct or in any way interfere with the ordinary traffic. As shown in the reports of tramway companies and the remarks of the chairmen at the annual meetings, the proprietors are fully alive to the importance of the subject, and are strongly inclined to take the necessary steps to replace horses by mechanical power. But as public opinion had to be educated in the first instance as regards the tramway itself, so also must it be enlightened respecting the traction; meantime, nothing will be gained by forcing legislation.

EARLY RAILWAY TUNNELS.

THE first railroad tunnel in the United States was built by Solomon W. Roberts (subsequently chief-engineer North Pennsylvania Railroad), on the Allegheny Portage Railroad, in Pennsylvania, in 1831-33. This railroad was built to connect the Central and Western Divisions of the Pennsylvania Canal, and was commenced on April 12, 1831, completed March 18, 1834; total length from Hollidaysburg to Johnstown, 36½ miles. The tunnel, 901 ft. long, was cut through slate 25 ft. wide by 21 ft. high, arranged for double track, and, like the "Summit Level" Tunnel, arched for the first 150 ft. in at either end. The side-walls and arch were of stone 18 ins. thick; area of excavation, 525 ft.; contract price, \$1.47 per cubic yard for excavation \$9.50 per perch (25 cubic feet) for tunnel masonry. The miners were paid \$13.00 per month and found. Prices for outside work: "Common excavation," 9 cents; embankment and overhaul, 14 cents; solid rock, 45 cents; slate, 25 cents; hard-pan, 30 cents; slope-wall, 45 cents.



EXTENSION OF THE NEW YORK ELEVATED RAILROAD STRUCTURE.



BRIDGE OVER THE RIVER SARPSFOS: NORWEGIAN STATE RAILWAYS.—CARL PIHL, ENGINEER; BERGHEIM & LECOQ, CONTRACTORS.

BRIDGE OVER THE SARPSFOS.

THE Sarpsfos Bridge, of which we give an engraving, is a very interesting example of a combined road and railway bridge most picturesquely situated over a grand river fall in Norway. Mr. Carl Pihl, as is well known, is one of the most powerful supporters of the narrow gauge system, and he has adopted the gauge of 3 ft. 6 ins. for Norway, with light rails and a small weight on the heaviest loaded wheel. The line upon which the Sarpsfos Bridge occurs is, however, of the ordinary gauge, and the engines and cars are also of the normal description. Thus the strains are calculated upon the assumption that the bridge would be covered with engines and tenders weighing respectively 37 tons and 27 tons, and measuring 14 meters from buffer to buffer.—*Engineering.*

THE WESTINGHOUSE BRAKE.

We illustrate the latest form of brake rigging devised by Mr. Westinghouse for railway carriages. The whole arrangement may be briefly explained. The air cylinder in the center of the frame contains two pistons, each of which is connected to the rod extending to the rigging. The compressed air is admitted to the center of the cylinder from the reservoir, as shown. On each side of both pairs of wheels a triangular braced frame extends, at each extremity of which is hung a brake block. A rod from the middle of this frame takes hold on one side of the lower end of a central lever, and on the other it is attached to the same lever at a point coinciding with the center of the axle. To the upper end of the lever the rod connected with the piston of the

falls far short of meeting the requirements of a perfect and permanent road. There is too much wear and too much expense in repair in all material hitherto used on common roads, and the question is—and it is one of vital interest to the whole country—can not a solid, permanent road be made cheaper, better and more durable than can be made from muck, plank or gravel?

"I propose to demonstrate that a road can be made that has every advantage over gravel or stone turnpike, or plank road; that the road can be put down for less money in the first place; that the road is a more efficient agent in its own construction than any other road; that the weight of material is 75 per cent. less than the same of any other road; that it costs far less in the matter of wear and repair than any other road—a road that ought to, and ultimately will, revolutionize to a great extent the entire internal transportation of the whole country. It is not the purpose of this communication to present many arguments or objections against the common road system now in use, but to demonstrate the entire practicability of an iron roadway for common wheels to run on, and, where practicable, enough sand or gravel to cut and dry the clay for a roadway for the horses.

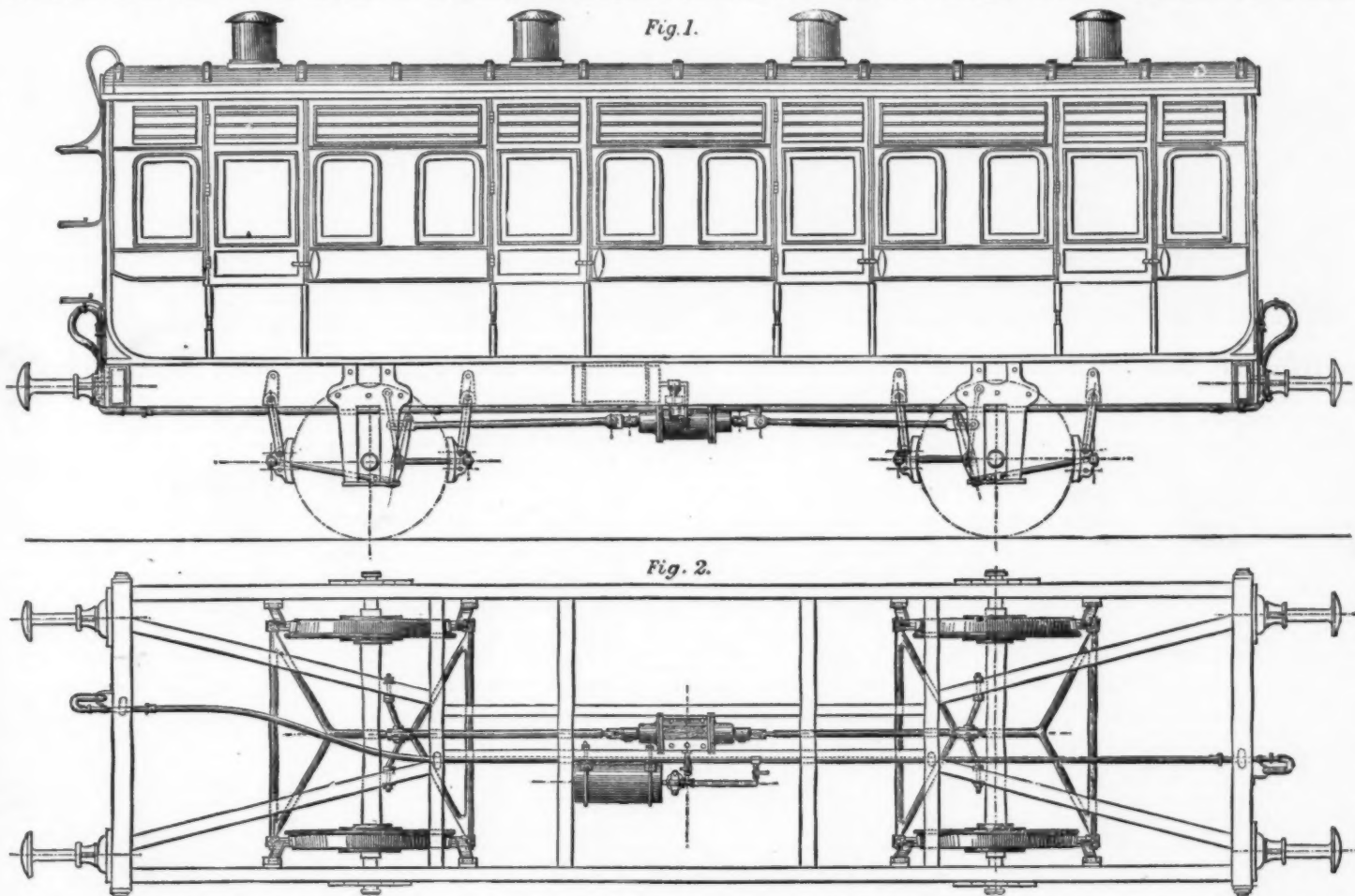
"I lay it down as a fundamental proposition, that will probably provoke no dispute, that it is mainly the vehicle and the load that needs a solid and unyielding foundation. I propose to lay down my road somewhat on the street-car track plan, the iron to be say eight inches wide, one-fourth of an inch thick; the edges turned up, say a half inch, and the bars to be sixteen feet in length, resting on a plank eight inches wide and three inches thick, the plank being held in position either by cross-ties eight feet apart or on posts three feet long,

PLUMBING.

LEAD pipes are put up with brass bands, and "tacks," which are small flat castings of hard metal, soldered at the middle or edge to the pipe, and then screwed to the board on which the pipe runs. The brass bands are used where several pipes run so close together that there is not room for tacks, and are strips of sheet-brass, bent to fit the pipe, and fastened by screws at the ends. There should be enough points of attachment to prevent the pipe from sagging or getting out of place by the contortions which expansion causes in it; and iron hooks and nails, which cut their way into the lead as it moves, should be avoided.

Pipes should never run, as is often seen, suspended between the beams of a floor. If it is necessary to carry them between the floor and ceiling, boards should be fitted in at the proper inclination, and the pipes laid on them; then there will be no danger of sagging, with the probable consequence of a torn or burst pipe in the worst possible place. After the pipes are so laid, it is well in country houses to fill in around them with sawdust or planing-mill chips, and the floor over them should be screwed down. However, pipes should not run under floors or in partitions if it is possible to avoid it, but always on boards fixed to walls or ceilings of kitchens, closets, or store-rooms, so that the whole length is easily accessible.

Lead pipes are joined by flanging out the side or end of one into a rude cup, and sharpening the end of the other to fit into it; the portions next the joint are then scraped bright, and at a certain distance rings of lampblack and grease are "smudged" around each pipe, and a mass of hot solder



THE WESTINGHOUSE AUTOMATIC BRAKE: AS USED ON THE LONDON, BRIGHTON, AND SOUTH COAST RAILWAY.

air cylinder is attached. These connections can be adjusted by means of the pins and holes shown in the drawing. The central lever is hung on a pair of swinging and diverging links fastened to the carriage frame. In operation, when the compressed air drives forward the piston in the cylinder, the rod connected with it is advanced, carrying forward the whole system till the inner brake block grips the wheel; the links and lever then have an abutment, and the piston, still advancing, the rod throws over the central lever, the lower end of which is attached to the frame carrying the outer blocks, and the latter are thrown on. It will be seen that the inner blocks thus grip slightly before the outer one, but only to an inappreciable extent. This form of rigging is now being attached to the London, Brighton, and South Coast Railway stock, where the automatic brake is definitely adopted. We may add that, light as the rigging appears, Mr. Stroudley, after a careful and exhaustive series of trials, has greatly reduced the weight while maintaining the arrangement.—*Engineering.*

IRON TRAMWAYS FOR WAGON ROADS.

A CORRESPONDENT writes to the Chicago Times from Huntington, Ind., as follows:

"The recent embargo on the rural traffic of the country has demonstrated the absolute necessity of a better means of country communication than that afforded by rigging up a roadway of muck. No argument is needed to show up the utter futility of any attempt to make a good, permanent and economical road of surface soil, or, indeed, of soil of any kind. Experience has demonstrated that plank does not meet the requirements of the case, as hitherto applied, the element of decay standing as too large a factor against its economy. Gravel roads have been found to answer a better purpose where the material can be got at not too much expense; but even this material is open to the objection of rapid wear and wash, costly to keep in repair, and

sunk down to a level with the surface or a little lower. The posts are spaced eight feet apart, and the dirt or gravel firmly tramped under the planking. Suitable and simple frogs are provided to hold the ends of the bars in position, and the frog is placed under the middle also, making the frogs eight feet apart. The frogs secured to the plank with bolts clutch over the outer edge of the iron bars and provide an easy means for the wheels to get on or leave the track.

"The track may be put nearly or quite on a level with the surface of the road. This track will be absolutely solid, and is so as soon as laid down, and consequently a great help in its own construction. There is no wear on the wood, and the posts, being all under the surface, are not exposed to rot, and the plank can be treated to a coating of pitch, and can readily be replaced. At the present market rate the road would cost as follows:

	Per Mile.
Iron rails.....	\$1,250
Planks.....	211
Bolts.....	40
Posts.....	130
Frogs.....	150
Labor.....	400
Total.....	\$2,181

"A small outlay will keep the road in repair, less than is now expended yearly in working on the roads. This track, if properly put down, is good for twenty years, is always good, and capable of sustaining any load that may pass over it."

THE Bey of Tunis has signed the decree which concedes the connection of the Tunisian Railway with the railways of Algeria. A tunnel just outside the station has been almost pierced, and next May it is expected that upwards of twenty miles of railway will be at the service of the Tunisian public.

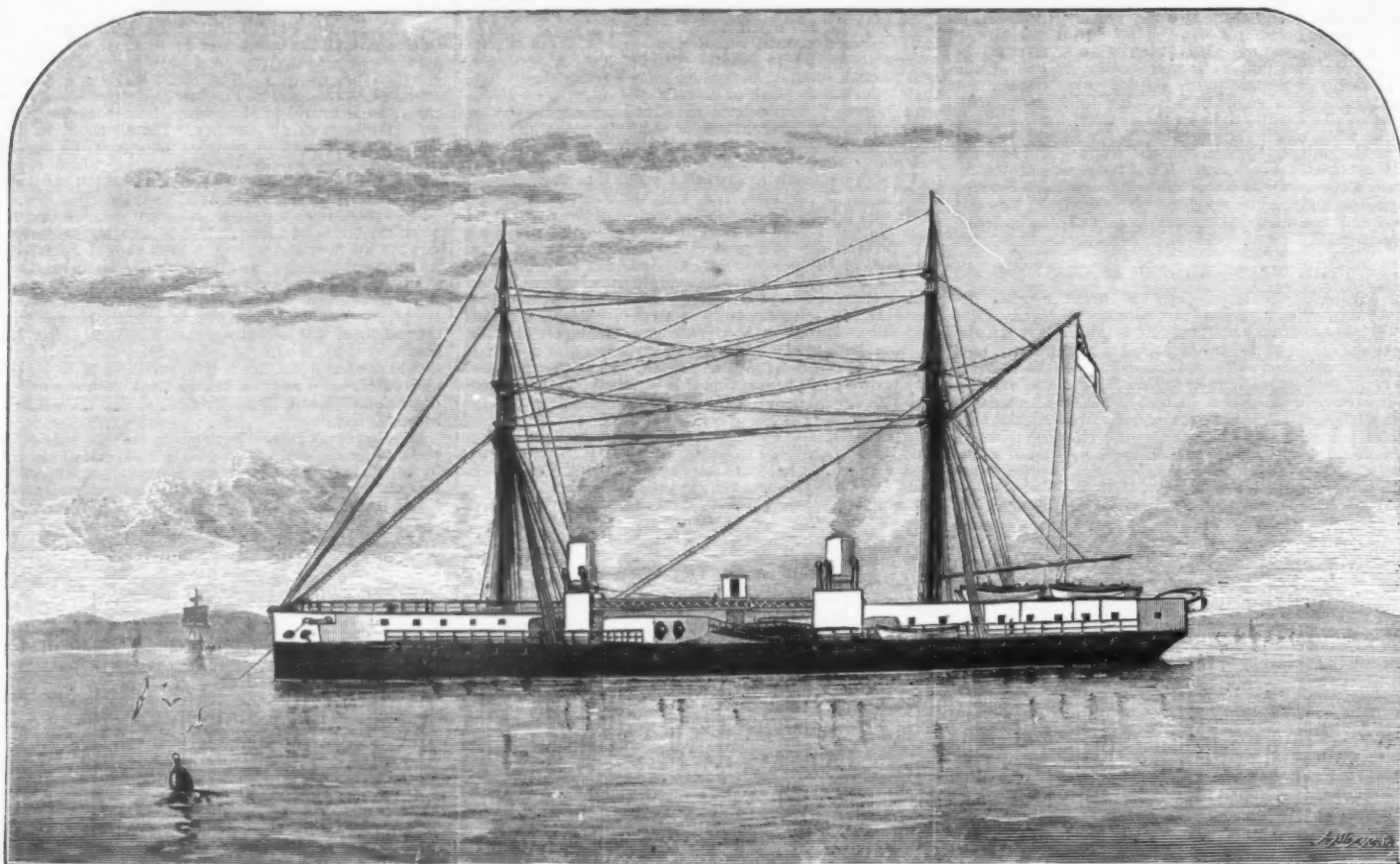
wiped around the junction, which adheres to the bright parts but not to the lampblack, thus making a neatly defined oval lump.

The quality of the solder is important. The smallest taint of zinc, even a few filings in a pot of solder, renders it brittle and unfit for good work. Commercial solder usually contains a little impurity of this kind, which has to be removed by burning with sulphur. The solder is melted and kept red-hot, and stirred with a lump of sulphur, which must be kept always below the surface to prevent its taking fire. The zinc is gradually separated and rises to the surface as sulphide, and is skimmed off, leaving the solder pure.

Lead can be soldered perfectly to lead or tin, and also to brass or copper, if the surface of the brass or copper is cleaned with acid and roughened with a rasp to make the solder adhere, but not at all to iron. In entering a lead into an iron waste-pipe, a poor plumber fills the joint with putty, which cracks or is eaten by mice in time; but a first-class workman solders to the end of the lead pipe a brass or copper ferrule, and this when introduced into the iron pipe gives resistance enough to allow the joint to be calked with melted lead, making a perfect and durable junction.

Iron and brass pipes are joined by means of cast fittings—branches, tees, bends, sleeves, etc.—into which the pipes are screwed, red-lead paint being first daubed over the screw. Much of the neatness of the work depends on the precision with which the pipes are cut off, and the appearance is seldom so good as a first-class job of lead-piping. Both iron and brass pipes are put up with brass bands. The brass pipes, after they are done, should be varnished with a good coat of shellac, or they will soon corrode and look badly.

The system of pipes should be so laid out that they will not cross each other when running nearly horizontally. In that case one must either dip under the other, forming a "bag," or, what is nearly as bad, must jump over it, forming a chamber which is soon filled with air which accumulates from the bubbles carried along in the water, and this



THE NEW BRITISH IRON-CLAD INFLEXIBLE. THE LARGEST AND STRONGEST WAR SHIP AFLOAT.

being pent up, unable to escape either way, stops or greatly checks the flow of water. The necessity of dodging around gas-pipes often gives trouble in a similar way. Of course a "bag" in a pipe traps it, making a similar air-chamber of the length of pipe adjacent to it, besides its further defect that the water cannot be drained out of it.

In a house with complicated plumbing, the laying out of the work so that all the pipes shall follow their course without interfering, the shut-off cocks shall come in accessible places, and the whole be kept well together, demands skill and judgment of the highest order; and an experienced eye will recognize the thoughtful and thorough workman far more in the precision with which the pipes fall into their places, and the neatness of their lines, and the mode of turning up their ends, than in the shiny fittings or polished marble.

Cast-iron waste pipes are put up with hooks and straps of iron, and must have a strong support at every joint. The parts are joined by inserting the small end of one into the socket or "hub" of the other, putting in a little hemp or oakum, and then pouring in melted lead or solder, and compressing it with a caulking iron. To lessen the corrosion of the iron the pipes should be painted. They may be dipped in hot tar, which is good, but makes the pipes disagreeable to handle unless they have a longer time to dry than can generally be allowed. Next to tar, red-lead paint makes the best protection. Two coats should be put on, one before the pipe is put up, to make sure of reaching all parts, and a second afterward to make the whole neat and uniform. The inside of the pipe can be coated by pouring in liquid paint and turning it around; but it is not usually done, and it is doubtful whether the paint resists the ammonia and other gases inside the pipe long enough to do much good. White-lead paint should not be used unless on top of a coat of red-lead, as it corrodes the iron. If red-lead cannot be had, the iron may be whitewashed with common lime wash, and the white-lead paint put over this, which will form a tolerable substitute.

In entering an iron pipe into the drain, care must be taken not to put the iron so far in as to choke the drain; the socket is partly filled with oakum, and cemented with hydraulic cement. It is a great advantage to join the iron pipe to the drain by means of a Y branch, of which one opening is closed only by a plug, which can be removed, and the junction of the soil-pipe and the drain, where obstructions frequently occur, cleaned without disturbing either pipe.—*American Architect*.

H.M.S. INFLEXIBLE.

The Inflexible was commenced at Portsmouth Dockyard in February, 1874, and launched April, 1876; is a twin-screw, double-turret ship, with a central armored citadel. She was designed by Mr. Barnaby, the Director of Naval Construction at the Admiralty, and at a meeting of the Institution of Naval Architects in London he describes the vessel in the following language: Imagine a floating castle 110 ft. long and 75 ft. wide, rising 10 ft. out of water, and having above that again two round turrets, planted diagonally at its opposite corners. Imagine this castle and its turrets to be heavily plated with armor, and that each turret has two guns of about 80 tons each. Conceive these guns to be capable of firing, all four together, at an enemy ahead, astern, or on either beam, and in pairs toward every point of the compass. Attached to this rectangular armored castle, but completely submerged, every part being 6 ft. to 7 ft. under water, there is a hull of ordinary form with a powerful ram bow, with twin-screws and a submerged rudder and helm; this compound structure is the fighting part of the ship. Seaworthiness, speed, and shapeliness would be wanting in such a structure if it had no addition to it; there is, therefore, an unarmored structure lying above the

submerged ship and connected with it, both before and aft the armored castle, and as this structure rises 20 ft. out of water from stem to stern, without depriving the guns of that command of the horizon already described, and as it, moreover, renders a flying deck unnecessary, it gets over the objections which have been raised against the low freeboard and other features in the Devastation, Thunderer, and Dreadnought. These structures furnish also most luxurious accommodations for officers and seamen. The step in advance has, therefore, been from 14 ins. of armor to 24 ins.; from 35-ton guns to 80 tons; from two guns ahead to four guns ahead; and from a height of 10 ft. for working the anchors to 20 ft. And this is done without an increase in cost, and with a reduction of nearly 3 ft. in draught of water. My belief is that in the Inflexible we have reached the extreme limit in thickness of armor for sea-going vessels.

The length of the vessel between perpendiculars is 320 ft., and she has the extraordinary breadth of 75 ft. at the water-line; depth of hold, 23 ft. 3½ ins.; freeboard, 10 ft.; mean draught of water, 24 ft. 5 ins. (23 ft. 5 ins. forward and 25 ft. 5 ins. aft); area of midship section, 1,658 square feet; and displacement when all the weights are on board, 11,407 tons, being the largest of any man-of-war hitherto constructed. She is, as before described, a rectangular-armored castle; the whole of the other parts of the vessel which are unprotected by armor have been given their great dimensions for the simple purpose of floating and moving this invulnerable citadel and the turrets by which it is surmounted. Her immense bulk, unprecedented armament, powerful machinery, and the provision for ramming, and for resisting the impact of rams as well as of shot and shell, have made it necessary that strength and solidity shall enter into every part of the structure.

Hull and Appendages.—While the cellular compartments of the double bottom have a little less depth than in the Devastation class, they are built up of heavier angle-irons and plating, and steel has been very largely employed for the purpose of securing great strength with comparative lightness of material. The hull is composed of flat and vertical keels, transverse and longitudinal frames, inner and outer bottom plating. The vertical keel is formed of steel plates ¾ in. thick by 40 ins. deep, and the flat keel-plates are of iron in two thicknesses of 1½ in. and ¾ in., the two being connected by angle-irons 5 ins. by 3 ins. by ¾ in. On the upper edge of the vertical keel the angle-irons by which it is fastened to the inner bottom plates are 3 ins. by 3½ ins. by ½ in. The framework of the vessel below the armor is composed of longitudinal and transverse frames. The former, eight in number, are formed of steel plates ¾ in. in thickness, the shelf-plate being of iron ½ in. thick. These frames extend as far forward and aft as is deemed practicable. Within the double bottom, which extends through 212 ft. of the ship's length, the transverse frames are solid, and are made water-tight at intervals of 20 ft. There are also intermediate bracket frames placed 4 ft. apart. Throughout the double bottom the transverse frames, which are likewise 4 ft. apart, are of the thickness of ¾ in., but are considerably lightened by having holes cut through them, the upper parts at the same time being much narrowed. Additional intermediate frames are worked in the engine-room in order to secure greater strength. The angle-irons forming the frames vary from 5½ ins. by 3 ins. by ½ in. to 3 ins. by 3½ ins. by ½ in. The outer skin plating of the bottom varies from 1½ in. in the garboard strakes to ¾ in., with the exception of the ends, where the thickness is increased to ¾ in., and behind the anchors, where the plating is doubled. The plating of the inner bottom, which extends through the length of the double bottom, and which, like the outer bottom, is made perfectly water-tight, is of the uniform thickness of ¾ in., except under the engines, where it is 7⁄8 in. As is usual in iron vessels, the stern of the Inflexible consists of a solid iron forging scarfed at its lower end to the keel-plates. The

stern post and after pieces of keel, which are formed of the best angle-iron, were also made in a single forging. The rudder is a solid iron frame filled in with wood and covered with iron plates. In consequence of its immense weight—some 9 tons—it is made to work upon double pintles in combination with the ordinary pintles and braces. It is moved by a tiller 4 ft. 6 ins. below the water. Indeed, the whole of the steam-steering gear will be placed below the water-line and armored deck, so that it will be impossible for the rudder head to be injured by shot or shell during an engagement. To receive the propeller shafts two iron tubes are constructed, one under each quarter. The foreparts of these tubes, where they leave the run of the ship, are supported by the framework of the hull, which is bossed out in a suitable form for the purpose, the after parts being supported by struts from the ship's bottom. There are four decks—the lower, middle, upper, and superstructure decks—the last being a middle-line erection placed forward and aft above the upper deck for working the ship, carrying and lowering the boats, etc. Outside the citadel the lower deck beams are covered with iron 3 ins. thick. This deck is depressed at the fore end so as to meet that part of the bow which is intended for ramming, thus conferring upon it greatly increased strength and resistance when engaged in butting an enemy's ship. It may be here stated that the ram of the Inflexible is of the spur kind, and though it is fixed at the present time, it will eventually be made to unship during ordinary cruises. The middle deck flat consists of ¼-in. plating covered with 3-in. deal planks, while the upper deck beams in the vicinity of the citadel are covered with 3-in. plating, and in other places with ½-in. plating. The beams, pillars, and bulkheads for supporting the various decks and platforms, and forming the different compartments and rooms, are arranged and fitted so as to give the greatest possible strength to the sides of the vessel. The largest beams are on the main deck. They are 14 ins. deep, while those on the upper deck are 10 ins., and those on the lower deck are 12 ins. deep. Every beam is either supported by wrought iron tube pillars or is trussed where pillars cannot be erected, the strongest being under the turrets. The two superstructures themselves in no wise add to the power of the ship, either for attack or defense. Their purpose in the economy of the ship is to afford accommodation for the officers and crew; and as the structures are erected on the upper deck, this will be of the very best kind, with abundance of air and natural light. Their dimensions are: fore superstructure, extreme length, 104 ft. 4 ins.; breadth, 21 ft. 4 ins.; after superstructure, extreme length, 105 ft. 4 ins.; breadth, 30 ft. The frames are formed of angle-iron, 7 ins. by 3 ins., placed 4 ft. apart, and between them are intermediate frames made of angle-iron 4 ins. by 3 ins. The ends are covered with ¾-in. plates, and the whole surface with 3-in. deals. The cabin walls are all coated with Welch's wood-faced cement, as a protection against the results of atmospheric condensation. The officers and men together will number 350. As a protection against the casualties of war and the sea, the hull is divided by means of transverse and longitudinal bulk-heads into no fewer than 135 water-tight compartments, and arrangements will be made for quickly removing therefrom any water that may collect therein through collision or other cause. Powerful steam-pumps, among which may be mentioned two of Friedman's patent ejectors, capable of discharging 300 tons of water each per hour, will be fitted. All the bulk-heads are provided with water-tight doors of an improved pattern, sluice-valves, man-holes, and water-tight scuttles. Water-tight doors can also be fitted, when necessary, to the bulk-heads passing through the coal-bunkers. Each of the water-tight compartments has been tested by hydraulic pressure. Great attention has been bestowed upon the question of ventilation, which in ships of the Devastation class, and, indeed, in all monitors of low freeboard, has been a source of considerable discomfort and

embarrassment. In the Infexible the fresh air will be drawn into the midship part of the vessel through a series of down-cast shafts, by means of eight powerful fans, worked by four of Messrs. Brotherhood & Hardingham's patent three cylinder engines. The air is then conducted into main pipes, which run around the sides of the hull to the extremities, and from these subsidiary or branch pipes discharge the air in ample quantities to every part of the ship.

Defense.—The protected portion of the ship is confined to the citadel or battery, within whose walls are inclosed the engines and boilers, the turrets, the hydraulic loading gear, the magazines, and, in fact, all the vital parts of the vessel. It measures 110 ft. in length, 75 ft. in breadth, and is armored to the depth of 6 ft. 5 ins. below the water-line, and 9 ft. 7 ins. above it. The sides of the citadel consist of an outer thickness of 12 ins. armor-plating, strengthened by vertical angle-iron guides 11 ins. wide and 3 ft. apart, the space between them being filled in with teak backing. Behind these girders, in the wake of the water-line, is another thickness of 12-in. armor, backed by horizontal girders 6 ins. wide, and supported by a second thickness of teak backing. Inside this are two thicknesses of 1-in. plating, to which the horizontal girders are secured, the whole of the armor backing and plating being supported by and bolted to transverse frames 2 ft. apart, and composed of plates and angle-irons. It will thus be seen that the total thickness of armor at the water-line strake is not less than 24 ins. The armor belt, however, is not of uniform strength throughout, but varies in accordance with the importance of the protection required and the exposure to attack. Consequently, while the armor at the water level is 24 ins., in two thicknesses of 12 ins. each, above the water-line it is 20 ins., in two thicknesses of 12 ins. and 8 ins., and below the water-line it is reduced to 16 ins., in two thicknesses of 12 ins. and 4 ins. The teak backing with which it is supported also varies inversely as the thickness of the armor, being respectively 17 ins., 21 ins., and 25 ins. in thickness, and forming with the armor, with which it is associated, a uniform wall 41 ins. thick. The depth of armor below the load water-line is 6 ft. 5 ins., but as the vessel will be sunk a foot on going into action by letting water into its double bottom, the sides will thus have armor protection to the depth of 7 ft. 5 ins. below the fighting line. The outside armor is fastened by bolts 4 ins. in diameter, secured with nuts and elastic washers on the inside. The shelf-plate on which the armor rests is formed of $\frac{1}{2}$ -in. steel plates, with angle-iron on the outer edge 5 ins. by $\frac{3}{4}$ ins. by $\frac{1}{2}$ in. The armor on the fore bulk-head of the citadel is exactly the same in every respect as that on the sides, but the armor of the rear bulk-head is somewhat thinner, being of the respective gradations of 22 ins., 18 ins., and 14 ins., and forming, with the teak backing, which is 16 ins., 20 ins., and 24 ins., a uniform thickness of 38 ins. It may also be useful to mention that before and abaft the citadel the frames are formed of 7-in. and 4-in. angle-irons, covered with $\frac{1}{2}$ -in. plates. The total weight of the armor, exclusive of deck, is 2,350 tons, and the total weight of armor, inclusive of deck, is 3,155 tons.

Turrets.—But the most singular feature in the design of the ship is the situation of the turrets. In the Devastation and Thunderer, and, in fact, all monitors afloat, the turrets are placed on the middle line, an arrangement which, though advantageous in some respects, possesses this signal disadvantage, that in double-turreted monitors only one-half of the guns can be brought to bear on the enemy either right ahead or directly astern. In the Infexible, however, the turrets rise up on either side of the ship *en echelon* within the walls of the citadel, the forward turret being on the port side, and the after turret on the starboard side, while the superstructures are built up along a fore-and-aft line of the deck. By these means the whole of the four guns can be discharged simultaneously at a ship right ahead or right astern, or on either beam, or in pairs toward any point of the compass. Besides these important advantages, the guns of each turret can be projected clear of the ship's side—in the case of the one turret to port, and in the case of the other turret to starboard. They can then be depressed enough not only to strike a vessel at close quarters below the line of her armor, but even to fire down upon her deck, should the enemy be ranged alongside. The walls of the turrets, which last have an internal diameter of 28 ft., and an external diameter of about 33 ft. 10 ins., are formed of armor of a single thickness of 18 ins.—the thickest ever manufactured, with the exception of the 22-in. experimental plate which was rolled at Messrs. Cammel & Co.'s works, at Sheffield, for the turrets of the Italian frigates—with backing of the same thickness, and an inner plating of 1 in. in two equal thicknesses. All experience has proved that, for many reasons, this arrangement is the best. The wood backing distributes the blow when struck, deadens the vibration, protects the fastenings, and stops the splinters, while the inner iron is also of advantage, since it renders the backing more compact, and also assists in arresting the passage of the *débris*. The height of the turret ports from the load-line is 12 ft., and a foot less from the fighting line, and all the plating in the wake of the guns is considerably strengthened.

Offense.—A very special interest attaches to the armament of the Infexible, not only because it consists of guns vastly more powerful than any yet mounted afloat, but because these guns are carried and worked on the new and remarkable hydraulic system which has hitherto only been tried in the fore turret of the Thunderer. Each turret weighs no less than 750 tons—including the guns—and having to deal with a moving mass of such enormous weight, and with the superadded difficulty of a floating and therefore unstable platform on which to revolve, it was determined to commence at this point with the adoption of the hydraulic system of Sir William Armstrong, as developed for gunnery purposes by his partner, Mr. George Rendel. The revolution of the turrets accordingly will be accomplished by hydraulic machinery, in a manner similar to that employed by the Elswick firm for turning swing bridges and great cranes. In such cases the weights dealt with have already exceeded that of the turrets of the Infexible; and so complete is the control afforded by hydraulic machinery in the movements of heavy masses in these analogous cases, that it is believed the turrets will, by this machinery, be rotated at any speed, from a complete revolution in one minute down to a rate as slow and as uniform as desired. The advantage of the high speed is plain; that of the slow but regular rotation will be apparent when it is remembered how much delicacy of adjustment is necessary for following with the aim an object moving rapidly and at a distance. Although the 81-ton guns will be worked on a system similar to that adopted in the case of the 38-ton guns of the Thunderer, yet as the design of the Infexible had not been completed before the decision to work the guns by hydraulic power was formed, a much more complete hydraulic gunnery ar-

rangement has become possible. The sponging and loading apparatus is still, as in the Thunderer, to be placed at duplicate fixed stations outside the turrets, and under the protection of the armored deck of the vessel. The muzzles of the guns are brought to the loading mechanism by revolving the turret and slightly depressing the guns. But there is no special loading port as in the Thunderer. All that is necessary is to depress the guns to the small angle required for bringing the muzzles below the level of the deck, which, still further to reduce this angle, is raised and inclined upward at the base of the turrets so as to form a sort of glacis, and to give cover to the muzzles without involving any considerable depression of the guns. By this means the objection brought against the greater depression of the guns of the Thunderer is avoided. A more important novelty is the manner of mounting the 81-ton guns in the turrets. Hitherto it has been the practice to place all heavy guns upon an iron structure, called the carriage, on which they rest by means of the trunnions. This carriage bears, besides the gun, the mechanism for elevating and depressing the gun, and for "tripping," and also in part the mechanism for checking recoil. Besides the carriage, again, there is the slide upon which the carriage runs. Now in the system adopted for the Infexible, Mr. G. Rendel has taken the bold step of dispensing altogether with a carriage, properly so called. Two guns will be mounted side by side in each turret. Each gun will be mounted so as to be supported on three points. The trunnions will rest on blocks sliding on fixed beams bolted down to the floor of the turret, while the breech will rest on a third block, sliding like the others between guides upon a beam or table. Behind each of the trunnion blocks, in the line of recoil, are two hydraulic cylinders, connected with them by piston-rods. The cylinders communicate with a pipe, on which there is a valve, which, on the recoil of the gun, opens and allows the pistons to run back slowly, checking the recoil. By reversing the apparatus, the gun can be run out again. The beam on which the breech rests is supported by a third hydraulic cylinder, fixed vertically beneath it in the turret. By this means the breech can be easily raised or lowered, thus elevating or depressing the muzzle of the gun, which pivots on its trunnions with a large preponderance toward the breech. In order to load, the muzzle is depressed until it comes opposite to an opening made in the upper deck before the turret. A hydraulic rammer works in guides through this hole, and the rammer head is hollow and is so constructed that when it is driven into the recently fired gun, and comes in contact with the sides of the powder chamber, a valve opens, and it discharges through a number of holes small jets of water, thus acting as a sponge, and extinguishing any remnants of the charge or of the products of the explosion which may have remained smoldering in the bore. It is then withdrawn, and a hydraulic shot lift raises up to the muzzle of the gun the charge, the projectile, and a retaining wad, and then a single stroke of the rammer drives them into the gun and home to the base of the bore. Again the rammer is withdrawn, the hydraulic piston under the breech of the gun elevates the muzzle, the turret swings around, and the shot is fired. A 9-in. gun, mounted experimentally in a turret at Elswick, and loaded on this system, was brought to the loading position, sponged, loaded, and brought back to the firing point in forty seconds. Comparatively equally rapid loading was effected with the 38-ton gun during the experimental trial of the hydraulic gear on board the Thunderer. Thus, the first advantage of the system is rapidity of fire; the second is economy of labor. One man only for each gun is stationed in the turret, another works the hydraulic rammer on the main deck, six or eight others are employed in bringing up the ammunition to the shot lift by means of a small tramway. There are two sets of loading gear for each turret; but even if both were put out of order, the gun could still be loaded with an ordinary rammer and sponge by a number of men stationed on the main deck. The adoption of the system enables very heavy guns to be carried in comparatively small turrets. Those of the Infexible are very little larger than those of the Devastation, so that with the old plan of having a numerous crew in the turret and running in the gun in order to load it by hand, only the 38-ton gun could be carried. As it is quite possible that the Infexible will be armed with even more tremendous weapons than the 81-ton guns, this has been held in view in designing the ship; and, by a slight modification, it will be possible to mount in each of her turrets a pair of 160-ton guns, with a length of 30 ft. and a caliber of 20 ins. The armament of the Infexible will be composed of four of the heaviest guns—except those making for the Italian vessels—ever constructed, of which the experimental 81-ton gun completed at Woolwich and tested is the type.

Motive Machinery.—The machinery was constructed by Messrs. John Elder & Co., of Glasgow. Each screw will be driven by an independent set of compound engines with three vertical inverted cylinders of the collective power of 4,000 horses, giving an aggregate power of 8,000 horses (indicated) for both sets of engines. The diameter of the high pressure cylinder is 70 ins., and the diameter of each low pressure cylinder is 90 ins.; the former is placed between the two latter. They are steam-jacketed, and are connected together by stay bolts continued to bulk-heads, so as to serve as ramming checks. The pistons have a stroke of 4 ft., and the number of revolutions expected is sixty-five per minute. The piston rods are double, and are connected by crank crossheads. They are each 7 ins. in diameter, the connecting rods having a diameter of 9 ins. and a length of 7 ft. 6 ins. The valves are of the piston kind. They are worked by link motions and levers, and are reversed by an ingenious combination of steam and hydraulic power. The engines at starting are assisted by auxiliary steam gear, the valves of which are fitted to the receiver. The steam from the low pressure cylinders is exhausted into independent surface condensers, having a total cooling surface of 10,000 square feet. The steam is condensed in the interior of a series of tubes $\frac{3}{4}$ in. external diameter, of which each condenser has no less than 6,650. The condensers are constructed to be worked as common condensers. The circulating pumps are actuated by separate engines, each having its own feed, bilge, and air pumps, worked by levers from the crossheads. The air pumps are made of gun-metal, with a diameter of 34 ins. and stroke of 2 ft. 3 ins., the water being discharged below the armor deck. With respect to the centrifugal pumps, it may be mentioned that they are judiciously placed at so high a level in the vessel that in the case of leakage occurring, by which the ship's bottom may be flooded to as great a depth as 12 ft., they can be worked with perfect freedom. There are also double-acting hand pumps, each two coupled; feed donkey engines, each with double-acting pumps 4 ins. in diameter; bilge donkeys, each with double-acting pumps 6 ins. in diameter, and fire engines, with double-acting pumps $\frac{3}{4}$ ins. in diameter. It may be mentioned that the engines

which work the circulating pumps are also made to pump out the bilge, in the event of the ship springing a leak or sustaining damage from being rammed; that the centrifugal pumps are to be sufficiently powerful to perform the same work in case of emergency; and that a Kingston valve is fitted through the bottom in connection with each fire pump. Each cylinder is fitted with an expansion valve, having a variable cut-off, with an extreme range of from one-sixth to one-half stroke. These valves are cylindrical gridiron valves, of phosphor-bronze, $\frac{3}{4}$ in. in diameter, working on cast iron gridiron seats, and giving a minimum of clearance between the expansion valve and main slide. They are worked by an eccentric on the crank shaft and a slotted lever, and are all connected to a shaft in front of the engines, so that they may be thrown out by a single handle. Each engine is also fitted with a common injection apparatus. The crank shaft is formed of three pieces, the diameter of the bearings being 17 $\frac{1}{2}$ ins. The propellers will be about 20 ft. in diameter, and will be worked outward, the thrust being at the after end. The shaft tubes are of wrought iron, supported by struts, while the shafting will be made of Whitworth fluid compressed steel, with solid couplings. It will be hollow, the inner diameter being 10 ins. and the outer 16 ins. The faces of the high-pressure cylinders are formed of phosphor-bronze, 2 ins. thick; the liners of the cylinders are also constructed of the Whitworth compressed steel, which possesses properties rendering it not only extremely light, but at the same time much more trustworthy than the ordinary metal used for this and shafting purposes. Each engine will be fitted with a governor, to prevent racing in stormy weather; and in addition to the hand gear, small auxiliary engines will be erected for turning the main engines.

Boilers.—The steam is to be furnished by twelve boilers, eight single-ended and four double-ended. They are constructed of the best Lowmoor plates, tested to 21 tons lengthwise and 18 tons crosswise, and the pressure of steam will be 60 lbs. per square inch. The four double-ended boilers are 17 ft. long, 9 ft. 3 ins. wide, and 14 ft. 3 ins. high, with four furnaces in each. Four of the single-ended boilers are 9 ft. long, 13 ft. 7 ins. wide, and 15 ft. 7 ins. high, with three furnaces each, and the four remaining single-ended boilers are 9 ft. long, 11 ft. wide, and 13 ft. 4 ins. high, with two furnaces, each having a separate fire box. All the boilers are to be clothed with four thicknesses of boiler felt, and covered with galvanized sheet iron, and are stayed to prevent their moving by concussion when the ship is engaged in ramming. They are to be supplied with water by four feed pumps, which are attached to each engine, the pumps being $\frac{7}{8}$ ins. in diameter, and having a stroke of 2 ft. 3 ins. In the event of the feed pumps receiving injury, the boilers are provided with four small auxiliary engines—one in each boiler room—and having separate connections with the boilers. The two auxiliary engines which are used for washing the decks are also arranged to work the fire engines in the engine room. The safety-valves are fitted with springs upon an improved plan. The smoke pipes, of which there will be two, are 65 ft. high from the dead plate of the lower furnaces. The bunkers, which are placed at the water-line along the unarmored sides of the ship, where the entrance of shot or water cannot injure them, are built to store 1,200 tons of coal, and are so disposed that their contents can be approached from the upper and lower compartments independently of each other.

Rig.—The Infexible is also to possess sail power, with respect to the advantages of which, however, considerable diversity of opinion exists. She will be brig rigged, having two iron masts, but no bowsprit or stay gear. The foremast will be 36 ins. in diameter, and will measure 83 ft. 6 ins. from the deck to the head, while the mainmast will have a diameter of 37 ins. and a height of 96 ft. Each will have a topmast and topgallantmast, with lower yard, topmast yard, and topgallant yard. The total area of sails will be 18,470 square feet. In time of war it is intended that the ship will carry no masts, except for signal purposes. The anchors, of which there are to be four, will be of Martin's self-canting pattern.

Weights.—The estimated weight of the hull is 7,300 tons. The engines will weigh 614 tons. The propellers, shafts, and stern fittings will weigh 151 tons each; the boilers, smoke pipes, carings, etc., 522 tons; and the water in the boilers when ready for steaming is estimated at 190 tons.

Cost.—The cost is estimated as follows:—Materials, \$269,000; engines and appendages, \$100,150; boilers, \$20,600; labor, \$132,000. As a new type of a man-of-war, the leading features of the Infexible may be summed up as follows:—The armor is confined to the central fighting portion and to the main substructure which floats the ship. An armored deck 7 ft. under water divides the vessel into two separate portions. The unarmored ends are so constructed that the vessel will float even when they are penetrated by shot. The ship has a wide beam and a comparatively light draught of water. The deck houses give a high bow and stern, and the turrets are so arranged as to enable all four guns to be fired both ahead and astern or on either beam. The Infexible has been accepted as the type of the British future line-of-battle ships, and the Admiralty have determined on building others, two of which are already under process of construction, viz., the Agamemnon at Chatham, and the Ajax at Pembroke. These sister vessels are to be of reduced dimensions. They will be 280 ft. long, 66 ft. wide, and will have a displacement of 8,500 tons, with a mean draught of water of 25 ft. They are to carry armor 18 ins. thick, and an armament of two 38-ton guns in each of the two turrets. The indicated horse-power is to be 6,000. In perusing the foregoing description of the Infexible it has been seen that her double bottom is divided and subdivided into an unusual number of spaces, and that the water-tight bulk-heads have been introduced to an extent not before attempted; and, in fact, almost every conceivable precau-

* This alloy is now gaining favor for cylinder valve faces where high pressure steam is used, and for bearings where heavy pressures are applied. Its component parts consist of copper, tin, and phosphorus, and it is capable of being made tough and malleable, or hard, according to the proportions of the several ingredients. It is rendered so liquid in the molten state by the addition of the phosphorus that it forms very clean castings. Messrs. Levy & Kugel, of the Val Benoit Nickel Works near Liège, Belgium, have, for a number of years past, been engaged in making experiments for the purpose of improving bronzes of this kind. The results of their experiments are thus summed up by M. Dumais:—"The color, when the proportion of phosphorus exceeds $\frac{1}{2}$ per cent., becomes warm and like that of gold largely mixed with copper. The grain and fracture approximate to those of steel, the elasticity is considerably increased, the absolute resistance under a fixed strain becomes more than doubled, the density is equally increased, and to such a degree that some alloys are with difficulty touched by the file. The metal, when cast, has a great fluidity, and fills the model perfectly. By varying the dose of phosphorus the particular characteristics of the alloy which are most desired can be varied at will." In a series of experiments at the Royal Academy of Industry at Berlin, a bar of phosphor-bronze—proportions of components not stated—under a strain of 10 tons resisted 962,980 pounds, while the best gun-metal broke after 101,550 pounds. In Austria the following comparative results have been obtained:—Absolute resistance (lbs. per square inch): Phosphor-bronze, 81,706; Krupp cast steel, 73,256; ordnance bronze, 31,792.

tion has been taken to make her secure against the ram and the torpedo. If, however, she should be fairly struck by several powerful fish torpedoes it is quite probable she would be crippled, water-logged, or possibly sunk. The question, therefore, presented is whether two vessels of smaller dimensions, each carrying two 81-ton guns instead of four, would not have been a safer and in some respects a better investment.—*Engineer*

SELF-STOPPING BEAMING MACHINE.

DURING the past twenty-five or thirty years, improvements in cotton machinery, though not distinguished in individual inventions by any remarkable advance, have been numerous, and, in the aggregate, extremely important. The increased productiveness of a mill in the present day is very much owing to these changes. The direction they have taken is toward rendering every machine a perfect automaton, requiring much less of the supervision of the attendant. The latter, in consequence, is enabled to take charge of an increased number of machines, at an expenditure of less physical labor and attention than before. The operative thus gets better wages, while production is greatly cheapened, and the article turned out is of a superior quality. These improvements have been made in every section of the spinning and manufacturing departments. One of the most recent is the application of a stopping motion to the beam warping mill. There have been many attempts to accomplish this object, each attended with more or less success; but it is only recently, so far as we are aware, that the full measure has been accomplished. Among these attempts, one of the most effective is the invention of Mr. Wm. Rosseter, which was patented by that gentleman, in conjunction with the late Mr. Mather, of Salford, Eng.

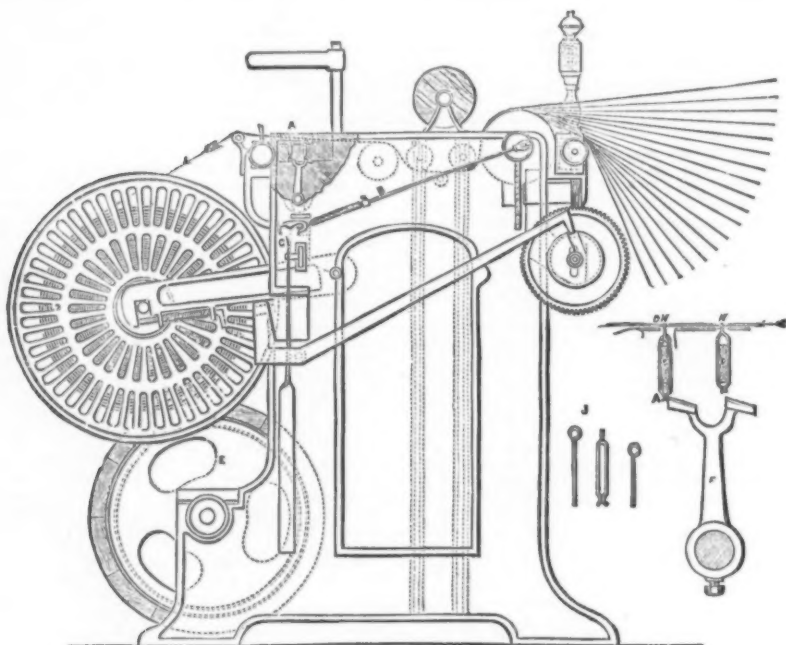
With the aid of the accompanying engraving, our readers will readily comprehend the principle of the improvement. Our illustration represents a side elevation. The mill, as will be observed, in its general construction is of the ordinary form; but the half-dozen or so of falling rods are dispensed with, not being necessary with Mr. Rosseter's invention. The yarn, coming from the creel, after passing through the reed and over the measuring roller, descends

absent, have been at their wits' ends to supply the vacancy with a winder sufficiently careful and attentive to be intrusted with the responsible occupation of warping.

Now, however, any winder can be taken to the warping mill from the winding frame, and charged with that duty without much fear of any mischief resulting. Should it happen that several threads break at a time, all must be pieced up before the machine can be started. In some cases, when a machine has stopped through the breakage of threads and has set to work again, it will continue working, though only a part of the broken threads are pieced up. A stopping motion which can be treated thus is delusive and untrustworthy. This cannot occur with the improvement under notice; all the threads must be pieced up before the machine can be started.

Beneath the threads passing through the detectors, HD, it will be observed that there are three horizontal plates, parallel to each other, over which the sheet of warp threads passes, in close proximity. These plates are arranged one on each side and one between the detectors, to perform two duties, the first being to prevent the machine stopping on account of a temporary slackness of a thread, and the second to enable each thread to act as its own "flucker," keeping clear the rings of the detector. As the loose fiber is deposited, it is instantly swept onward by the moving thread, and thus the detectors are kept free from liability to being clogged by the "down" thrown off in the process. These plates are preferably made of brass, as this material affords a good background, especially for colored yarns, enabling the operative to perceive at a glance whether all is right or not.

The brake attached to the machine stops the beam quickly, yet without a shock. Two rows only of detectors are shown in our illustration, but more may be used, so that any reasonable quantity of ends can be put upon a beam. The complicated methods of driving in use for some warping frames, such as friction disks, treadle and clutch driving gear, etc., are dispensed with in this instance, and a return to the old, simple plan of using the fast and loose pulley is effected. Reverting to the detector, the form illustrated at J, wherein the ring is cut on one side, permits the warper to insert the thread without taking the former from the bar



SELF-STOPPING BEAMING MACHINE.

under two small tin rollers, which, fixed in grooves, by their descent are sufficient to take up the slack from the creel on the stoppage of the machine, the small intermediate fixed roller sustaining the yarn, while the former descend on each side. The warp then ascends over the next roller, passing through the comb to the detectors affixed on the flat rods at A, thence over a series of plates to the beam. The two flat rods seen in section at A, and which extend across the machine, are shown in an enlarged form, GG, fitted with detectors. The latter are made from spring-tempered wire, and their two forms are shown at J, one having a full ring top, the ring of the second being imperfect, having a slot cut in it, the reason of which we will explain further on. The middle one of the three illustrations of the detector exhibits its form as adapted to fit upon the flat rods, the groove opening at the bottom. The flat rods are fitted with detectors, one for each thread, the latter holding the detector in the position shown at H, Fig. 2. Being, as above stated, made of spring-tempered wire, the detectors grip the rods with a force or strength sufficient to preclude any risk of their being dragged or jerked off by the threads while working; at the same time they are easily removable by the operative for any required purpose. On the breakage of a thread, the detector, H, drops into the position exhibited at A, in the same figure, thereby coming into contact with the oscillating bar, F, which, acting upon the adjustable connecting rod, B, draws the spring lever, C, out of the detent, and stops the machine. It is necessary, before the machine can be started again, that every broken thread should be pieced up and passed through the detector, raising it to its original position, as shown at D. On the fracture of a thread, the action of the brake quickly arrests the movement of the beam, and it is rare that the broken end is carried above twelve or eighteen inches forward after passing the detector. The advantage arising from this is obvious—the loss of time spent in running the warp off the beam in search of the broken thread is entirely obviated, and applied to the more useful purpose of production. With an average quality of yarn, we do not think it would be a difficult matter, with this attachment, for a warper to superintend two mills, instead of one, as heretofore. This improvement will also remove a great difficulty often experienced by managers of mills or winding masters, who, when a warper has been unavoidably

or using a hook, and thus it facilitates piecing the broken threads.

This machine is an improvement on one patented by John Charles Dickenson, of the firm of Messrs. William Dickenson & Sons, of Blackburn, which patent was granted in 1863 (No. 452); also upon one (673) granted to Mr. William Rosseter, of Accrington, in the same year. In the former of these machines the expanding and contracting combs were used; and in the latter an electrical stop-motion, which, being found too complicated and sensitive for ordinary use, has been displaced for the above simple mechanical arrangement, which has been found to give perfect satisfaction to the firms by whom it has been adopted. Messrs. William Dickenson & Sons, Blackburn, are the sole makers.—*Textile Manufacturer*.

REMARKABLE NATURAL GAS WORKS.

J. H. JAMISON, of Lake County, describes in a letter to the Lake County (Cal.) Bee the "Kelseyville Natural Gas Works" as follows: But with all the rain and mud, we have one of the grandest sights to be seen anywhere in the State—that is, the gas-mound situated on the eastern boundary of the town of Kelseyville, on an elevated piece of ground. The mound covers about one and a half acres of land. The gas is driven up through the surface of the soil over almost the entire area, and can be set on fire with a match; it will burn a bright blue light for hours, and can be seen for a long distance at night. This gas-mound belongs to John Kelsey and W. G. Young. They intend to put it to valuable use at some future time. There have been three small shafts sunk on it, one to the depth of eighty feet, which sends the gas up very strongly, so much so that it will not burn long at a time; but place a tin lid over the shaft or bored well, with small holes punched in it, and it will burn for several days and nights without going out. I have seen a pipe fastened on to the top of the shaft and led off twenty feet, with the end of the pipe put into a cooking stove, and the gas set on fire, and a pot of cold water set on the stove, and it boiled in twenty minutes, and cooked eggs as nicely as eggs were ever cooked anywhere. This gas can and will be used to run machinery, and can be used to light up the town and to heat up stoves with but little expense. How long it has

been in existence no one knows. It was discovered ten or twelve years ago. The gas burns at any and all seasons of the year, and gives a brighter light in the winter and spring. It is indeed a great natural curiosity among the many natural wonders of this country.

THE SPADE GUN.

JAMES L. BUSKETT, of St. Louis, has invented an in-trenching tool attachment to the ordinary army rifle, which, under his supervision, has been undergoing a very thorough and exhaustive test at the Springfield United States Armory for the past three weeks. The tool is very simple, being nothing more than an ordinary spade fitted to a recess in the butt of the stock, where it is carried when not in use. To turn the gun into a powerful spade or pry it has only to be inserted in a socket in the butt plate, the work of an instant only. The tests showed that in less than three minutes a soldier could throw up an intrenchment in soft soil sufficient to protect him from a rifle-ball, and in five minutes the same parapet could be thrown up in hard, frozen ground or stony soil. It is constructed with sufficient strength to be continuously serviceable, and so attached as in no way to spring or injure the arm. Another trial has been ordered by a board of line officers, to be conducted at St. Louis. The Secretary of War has expressed himself as highly pleased with the invention, and is confident of its great utility if adopted by the army.—*Washington Post*.

NEW STEEL-MELTING FURNACES IN RUSSIA.

By G. AREHN.

THE works in question, situated at Kama, about 500 miles from Nischni Novgorod, are Russian crown property, but are let on a contract for the production of 250,000 stand of breech-loading (needle) guns at a fixed price. In order to utilize the plant on the spot, it was thought desirable to add a crucible steel-melting plant; and under the direction of the manager, M. Bruneau, a Belgian, the furnaces, which are cheap in construction and economical in working, have been erected; they are gas-fired on Siemens' principle, charcoal being used as fuel. The gas producer is a shaft about 30 inches square, inside measure, and about 11 feet high, about 6 feet of the central part forming the space for the fuel, which is consumed by air introduced under pressure through a series of small rectangular apertures in the casing wall. The top is covered by a feeding hopper and slide-valve like that of the ordinary Swedish gas furnaces, and at the bottom is an arched opening of about three square feet leading to the gas exit passages, of which there are two, placed symmetrically one on either side of the shaft, and communicating by a short channel with the gas regenerators. A gas stop-valve is placed upon each passage, and the two are connected by an iron balance beam, so that when one valve is shut the other is open. The valves are flat iron disks with a plain iron stem, both parts being thickly covered with fire-clay. The valve edge is brought to a conical surface which bears against a seat of similar form. The melting hole, which is of rectangular section, about 3 feet long, 2½ feet deep by 1½ foot broad, takes eight pots of 60 lbs. capacity in two rows. It is contained in the center of a rectangular mass of brickwork, immediately between the gas regenerators, behind which are the air regenerators, the whole forming a block 5 feet wide, 19 feet long, and 3½ feet high above the ground level. The bricks in the gas regenerators are placed on end, and those in the air regenerators, which are of larger capacity, horizontally.

The ends of the furnace block are joined by a flue 2 feet square inside, in plan, and having in the middle a valve for reversing the exhaust current and two small chimney pipes through which the waste gases are discharged into the air. The current is reversed every half hour, the exhaust gas from the melting hole passing first through the gas regenerator and then through that for heating the air. The combustion takes place in a narrow slit formed between the top of the regenerator and the cover of the furnace. The melting hole is lined with a tempered mass of fresh and burnt fire-clay about 18 inches thick, the space for receiving the pots being slightly broader below than above; a tap-hole for removing slags is pierced through the center; the covers are made of similar refractory mass in cast-iron frame plates. When working upon rifle-barrel steel, containing 0.35 to 0.45 per cent. of carbon, these furnaces make from five to six meltings per day; but when producing bayonet steel, with 0.7 per cent., or tool steel, with 1.0 to 1.2 per cent. of carbon, which are less refractory, seven meltings may be obtained. They may be kept fired for seven days as a rule, but with good pots for eight or even nine days. The daily consumption of fuel is 550 cubic feet of charcoal per furnace, which suffices to melt 24 cwts. of the milder quality of steel, or about 23 cubic feet per cwt. melted. One of the most essential points in management is the air supply, great stress being laid upon the necessity of providing largely for the requirements of the gas, both in the producer and in the subsequent combustion. The cover of the melting hole requires to be replaced from five to six times daily, but those of the regenerators usually last throughout the week. The charge in the pots consists of refined cast iron and wrought iron. For barrel steel the mixture includes 14 lbs. of the former, 46 lbs. of the latter, and about 2 lbs. of borings and turnings (? steel). For bayonets 17 lbs. of cast and 30 lbs. of wrought iron are used. The refining of the cast iron is effected by melting it with an addition of ladle turnings, and running it into a slab, which is cooled by water and broken into fragments of a convenient size. When the steel ingots show a tendency to blow in the moulds, spiegeleisen, containing 15 to 20 per cent. of manganese, is substituted for a portion of the cast iron to the extent of 15 or 20 per cent. of the whole amount of the latter.

The melting pots are prepared on the spot from a mass containing clay, old potsherds, Russian and English graphite, and anthracite, the following quantities being required for a single pot:

	Lbs.
Clay.....	14
Old potsherds.....	14
Siberian graphite.....	6
English graphite.....	1
Anthracite.....	4

Great care is required in the incorporation of the materials to obtain a mass free from air bubbles. The crucibles are moulded in a plunger press and allowed to dry from two to three months before using. With one press and about eighty hands 275 pots are made daily. About 30 per cent. give out after the first melting, the remainder being used twice.

There are twenty similar furnaces in the works, ten of which are kept fired at a time, while the remaining ten are under repair.

CONCRETE AND IRON AS A BUILDING MATERIAL.*

A VERY interesting series of investigations have been lately made by Mr. Thaddeus Hyatt, of New York, well known as the inventor and manufacturer of the "lens light," upon Portland cement concrete in combination with iron, the endeavor being to explode the now recognized fallacy that iron is a fireproof material, and to show that its use in the form of iron beams in concrete floors is a perversion of its natural capacity when exposed to the action of fire, and also a waste of metal. Mr. Hyatt well observes that Fairbairn, in his work on the "Application of Cast and Wrought Iron to Building Purposes," has led a great many to believe that iron is fireproof, and that all so-called "fireproof" floors that have ever been made, with only one exception—the Safe Deposit Building—have been constructed in accordance with this belief. He points out how this fallacy has vitiated every floor construction made from Mr. Fairbairn's time to this. We are ready to acknowledge, as indeed any one practically acquainted with the subject must, the failure of those systems which combine iron in such a way as to expose it to the action of fire, and especially the danger of exposing the lower flanges of girders, as we find to have been the case in all earlier systems of so-called "fireproof" construction. Softened, indeed, by heat, the lower flange yields as a tie, and the girder no longer performs its function. The author, like other recent investigators, shows that if we protect this vital part of the girder from the heat by covering it or protecting it in a casing of concrete, properly compounded, a floor can be constructed equal in its fire-resisting qualities to those of the best fireproof safes. Our readers will say they know this already, and that there have been several capital systems introduced lately which completely immerse the iron in concrete or cover it in a casing of some non-conducting material (by the way, the author has omitted to refer to the best and latest of these), but Mr. Hyatt has gone further, and shown how mere flat ties and cross-bars inserted in the floor or beam of concrete below the neutral axis can be made to perform the office of resisting tension, the most vital force to be dealt with, simply and inexpensively. In his new building in the Farrington-road (illustrated in the work before us) the author shows a massing of the fireproof materials at the ceiling level, the main girders being completely embedded in concrete. In the "lens light" works Mr. Hyatt has succeeded in developing the principle in the construction of illuminating fireproof floors and roofs and "illuminating gratings," under the name of the "New Stone Light." In some of these floors the ceiling is upheld by series of blades of iron, which are notched upon the lower flanges of cross joists, and through these blades or ceiling-holders wires are inserted, forming a network to hold the concrete which completely covers the iron both on the top and bottom. But a more simple and quite as effective floor is obtained by omitting the floor joists and substituting flat tie-irons for them, which act as the tensile member, while the concrete itself becomes the compressive member of the beam or slab. This, then, is the principle of Mr. Hyatt's system—one very similar to the plan used by Mr. Matthew Allen, of Tabernacle-walk and Stoke Newington, and described by us some years ago. Flat bars or ties of iron are introduced about 2 inches or 3 inches deep and $\frac{1}{2}$ inch thick, placed about 6 inches apart, through which rods pass every 2 inches to 3 inches; these rest upon rolled joists placed about 3 feet from centers, and the whole embedded in concrete. The author proceeds to explain, in a very intelligible form and by the aid of excellently drawn illustrations, the rationale of this system. One important point is the relative amounts of compressibility between concrete and iron. The compressibility of concrete and also its resistance to extension have been investigated by the author. He used a bar of cement ten days old, fitted into a frame loosely to prevent bending, and the results were .048 inch in 50 inches in length, with a load of 1,000 pounds per square inch, the bar returning to its original length on removing the load. Thus the ratio of expansion was, roughly, the 1,000th part of length, and if the ultimate compressive strength is put at 2,000 pounds per square inch, the final compression is given as 1-500 part of length. This being the case, the tensile strain will be borne by the iron ties in any combination of the two materials, and Mr. Kirkaldy's experiments, given by Mr. Hyatt, confirm this conclusion. As regards, then, the compressive strength of concrete, we may put this generally at 2,000 pounds per square inch. The fireproof qualities of Portland cement, the ratio of its expansion and contraction, compared with iron, the effect of the two in combination when heated, etc., have also been investigated by a series of experiments by Mr. Kirkaldy for the author. Thus we find, from the thermal chart given, which shows the heat imparted to iron bars protected by 2 inches, 3 inches, or 4 inches thickness of concrete, that the temperature of the iron protected by 4 inches of concrete, after $5\frac{1}{2}$ hours' exposure to the heat, did not exceed 212°, or boiling point; in $8\frac{1}{2}$ hours it was 450°; and at the end of 13 hours 550°, or less than the melting heat of lead—an intense heat being kept up all the time, and the concrete being red hot. By a simple diagram it is made clear that it is waste of metal to use iron in the form of beams. By omitting the web and upper flange, and only substituting a flat tie for the lower flange, it is clearly shown that equal results are obtained, it being proved that the upper part of the floor or beam of concrete offers an excess of compressive resistance to the demands of the tie-metal below the neutral axis; or, as worked out, we get a resisting fulcrum of 150,000 pounds as against 120,000 pounds, the resistance of the metal in tension. The question as to whether the metal and concrete would act in concert and become united effectively is answered by numerous experiments, illustrated in Mr. Hyatt's treatise. Here we find that all the iron bars inserted in the bottom of the concrete beams were perfectly held while under strain, that both materials worked in harmony, and that better results were obtained when the metal blades were placed at the bottom of the section, and became tie metal, than when they lost the character of ties, and were made deeper—in the latter case the blades became so much metal lost. Without going into the figures of the author, which are clear enough, we may refer to two sections of floors given in the book. One represents a floor made of 7 inch rolled joists 1 foot apart, with a span of 15 feet, filled with concrete 10

inches thick. The iron of this floor weighs per foot super 14 pounds; weight of concrete, 100 pounds; safe distributed gross load, 384 pounds, or 270 pounds net. The other shows a floor of tie metal in blades, with cross bars running through them. The weight per foot of iron is only 5 pounds, thickness of floor 14 inches, the safe distributed gross load being 415 pounds, or 270 pounds net. These facts show the value of Portland cement concrete as a compressive member in floors and beams, and that iron can be combined with it in a matter which recommends itself to all engaged in construction, especially to architects and engineers. Every architect will, we are sure, hail the results and experiments thus brought forward by Mr. Hyatt as tending to indicate the value of a combination of concrete and iron in a safe, convenient, and economical form. Various forms of combinations of composite beams are shown, with the actual fractures, under various loads, in which the ties are placed in various ways within the concrete, to which we call the attention of our readers. We may just remark that floors or beams of great span may be composed by employing the metal in gridiron form in the top and bottom, the concrete forming the web connection.—*Building News.*

ASPHALTE.

As found in Nature, asphalt consists of a variable proportion of bitumen, intimately incorporated with calcareous or siliceous matter. Its origin is supposed to be due to the action of heat on vegetable substances, confined in the interior of the earth, forming a liquid bitumen or petroleum, which has, under pressure, probably from volcanic action, penetrated various limestone and sandstone formations in certain parts of the world. This product hardens on exposure to the air, and forms the rock asphalt used for road-making, etc., a preference being given to the combination of bitumen and carbonate of lime, as the adhesion is better than with the sand. The chief sources of supply are the mines at Seyssel, in the Jura Mountains; Val de Travers, in Switzerland; Limmer, near Hanover; those in Brunswick and at other places on the Continent, where it is obtained as a bituminous limestone of a dark-brown color, containing from 8 to 20 per cent. of bitumen—that containing about 12 per cent. being considered most suitable for general use. On being quarried it is broken up, melted, and cast into blocks, or ground into a powder, and can be procured in both forms in the market. A certain proportion of "grit" is usually introduced into the asphalt, the quantity ranging from one-tenth to quarter the bulk, and the quality, with regard to fineness, will depend on the purity of asphalt and the use to which it is to be applied. Refined bitumen or mineral tar is used as a flux, and by varying the proportion of materials a mastic can be produced suitable for any situation.

Directions for Use.—The following instructions for fusing asphalt are quoted from a book issued by Claridge's Asphalt Company: "The fire having been lighted in the caldron, put into the boiler 2 lbs. of mineral tar, to which add 56 lbs. of asphalt, broken into pieces of not more than 1 lb. each. Mix the asphalt and tar together with stirrer till the former becomes soft, and then place the lid on the caldron, keeping up a good fire. In a quarter of an hour repeat the stirring, and add 56 lbs. more asphalt in similar-sized pieces, distributed over the surface of that in the caldron. Again, cover the caldron for ten minutes, after which keep the contents constantly stirred, adding by degrees asphalt in the proportion of 112 lbs. to 1 lb. of tar until the caldron is full and the whole is thoroughly melted. When fit for use the asphalt will emit jets of light smoke, and freely drop from the stirrer. Should it be wished to convert fine asphalt into coarse, 25 lbs. of grit (clean and free from dust), passed through a No. 10 sieve, is to be added to each 112 lbs. of the former, in which case the proportion of tar will be $3\frac{1}{2}$ lbs. instead of 1 lb. for every cwt. In India and other tropical climates, where the asphalt is more readily fused, an excess of tar should be particularly avoided." Asphalt in a powdered state is also laid after being heated in iron vessels, by compressing in position with beaters and rollers, forming a surface without joint. The use of asphalt for purposes in connection with building operations has been derived within the last fifty years; evidences appear of its use, as a cementing material, in the walls of important cities and buildings of Egyptian, Assyrian, and Roman construction.

Tests.—A good asphalt should not be easily affected by changes of temperature, not becoming appreciably soft under a heat less than 140° F.; should be proof against the action of frost, impervious to damp, hard and non-inflammable, plastic, tenacious, and light, fusing readily at about 212° F.

Uses.—Asphalt is frequently used for preventing the rise of damp inside buildings, or as a damp-proof course in walls, and for covering floors or roofs when nearly flat. For foot-paths or roadways it wears well, but is liable to become dangerously slippery in wet weather. It is also used as a grouting for "sets" and wood paving. It is important that asphalt should be laid on an unyielding base, with an even and dry surface, usually formed of cement concrete.

Thickness and Weight.—The thickness for damp courses should be from $\frac{1}{4}$ in. to $\frac{1}{2}$ in.; for floors or roofs, $\frac{3}{4}$ in. or 1 in. spread in two layers, breaking joint in the bays; for foot-paths, $\frac{3}{4}$ in. laid in one layer, unless on verandas, or where the percolation of damp (that sometimes works through the joints) must be avoided. For roadways, about 2 ins. is the usual thickness, laid either as a mastic or in powder. A cubic foot of asphalt weighs from 125 lbs. to 130 lbs., so that a layer 1 in. thick will equal about 10 lbs. per foot super, a layer $\frac{3}{4}$ in. thick about 8 $\frac{1}{2}$ lbs. per foot super; 1 cwt. will cover about 14 ft. super $\frac{3}{4}$ in. thick. The advantages of asphalt for preventing the rise or penetration of damp in buildings are unquestionable. For paving it is not adapted for buildings where the difference of temperature would cause the moisture in the air to condense on the surface of asphalt, keeping it always damp. For roadways it admits of being easily repaired, as the asphalt can be taken up, re-melted, and relaid without loss. The danger to cattle traffic may be overcome by scoring, channeling, or by the insertion of wood slips or pegs, giving a better foothold than the smooth surface. A concrete formed with broken granite or limestone heated in the caldron with the asphalt before being spread—to insure thorough adhesion throughout the mass—forms a good roadway, wears well, and presents a rough surface, giving a good foothold. It is not advisable to lay asphalt when in large surface, or in exposed situations, at a greater slope than 1 in 10, as it is apt to run under the heat of the sun, and the adhesion to surface cannot at all times be depended on. It is sometimes used as a rendering on vertical surfaces—such as a lining for tanks—when a good key can be procured (as in the joints of brickwork); but even then the surface should not be large, not too smooth, perfectly dry, and, if possible, heated before the application. Artificial asphalt, consisting of limestone and liquid bitumen,

has been tried for paving, etc., but it is not so durable as the natural asphalt. Tar paving is cheaper but less durable than the asphalt, and consists of a concrete formed with limestone and coal tar laid in certain thicknesses, and finished off with a coating of finer stuff, the whole being consolidated by rolling.—C. W.

"Egbert" writes: For covering the extrados of an arch asphalt is much to be recommended, as in all new masonry, whatever care there has been exercised, there is always a certain settlement, causing, where ordinary lines are used, cracks and fissures, on account of their not possessing the elasticity of asphalt, and it often happens, where asphalt is used, that these small crevices solder themselves together, so to speak. The thickness necessary for coating any arch is not more than $\frac{1}{2}$ to $\frac{3}{4}$ in. The quantity of cement thus employed to cover a yard square is about 4 $\frac{1}{2}$ lbs. The following proportions were found by Col. Emy to be the best for the asphalt of Gauciac—2 $\frac{1}{2}$ pints (wine measure) of pure mineral pitch, 11 lbs. (avoirdupois) of Gauciac bitumen, 17 pints of powdered stone dust, wood ashes, or minion. For street paving it is imperative to have under the asphalt a bed of concrete of lime or gravel, the upper surface being rendered smooth by a coating of mortar. The thickness of the asphalt should never be less than $\frac{1}{2}$ in. to $\frac{3}{4}$ in., and there should be always added a small quantity of pure quicklime as a further preventive against the asphalt becoming soft under the heat of the sun's rays. The two kinds mostly used in London for street paving are the Val de Travers and the Limmer asphalt, but the former is more generally used.

Cost.—The Val de Travers is composed of rock from Neuchâtel, grit, and bitumen. The cost varies from 5s. 6d. to 9s. per square yard according to the thickness and quantity used. For roofing, asphalt is an excellent material. The mode of laying an asphalt roof is as follows: The joists must be rough boarded, then a layer of felt soaked in mineral pitch (concrete, sand, or cement can be used instead of this if preferred). The asphalt must then be laid about $\frac{3}{4}$ of an inch in thickness, and as hot as possible.—*Building News.*

THE BRIGHTON ABATTOIR.

By ANDREW J. LAWSON.

COMPARATIVELY few people in Boston and its vicinity are familiar with the locality where the business of slaughtering cattle, sheep, and other animals is carried on, and which constitutes the market or distributing point of the fresh meat which the great Boston stomach absorbs every day.

The Brighton abattoir, owned by the Butchers' Slaughtering and Melting Association, was erected under the direction of the State Board of Health of Massachusetts in 1872. Previous to this year none of the slaughtering establishments at Brighton were of any great magnitude, but in each the business was carried on in an unsatisfactory, unsanitary and wasteful manner. The result was the existence, within a few miles of the center of a great city, of a great nuisance, endangering the health, if not the lives, of several hundred thousand inhabitants.

In 1870, through the efforts of the citizens of Brighton, an act incorporating the Butchers' Slaughtering and Melting Association was passed by the Legislature. A corporation was accordingly formed; the capital stock was to consist of \$200,000. All the plans of the works of the association required the approval of the State Board of Health before they could be used. The passage of the act met with such opposition that not a dollar of the stock was subscribed for. After some modifications of the act, and a yielding on the part of the Board of Health, in the meantime nearly twenty of the slaughter houses having been closed by the Board, the butchers, to whose enterprise and intelligence the success of the great abattoir is largely due, a new plan for a slaughtering house, etc., was devised, and the result was the acceptance of the charter of the present association.

The amended law contemplates an abattoir some one hundred acres in extent, in order to respond to the growing requirements of the association, whose business is constantly enlarging. In 1872, a tract of land containing fifty acres, situated on the border of Charles River in the town of Brighton (since become a part of Boston) and lying about midway between Brighton and Watertown markets, was selected; but it was not until June, 1873, that operations were commenced on the abattoir. The buildings at that time consisted of the rendering house, a building 200 feet long, 80 feet wide, and five stories in height; a block of ten cattle slaughter houses, 380 feet long, 30 feet wide, with sheds and yards attached; a block of six sheep slaughter houses, 150 feet long and 80 feet wide; the engine and boiler, and a block of ten stables. At this time the abattoir was regarded a great success, yet it was far from perfect. Butchers, too, still continued the business outside, but subsequent legislation compelled them either to discontinue their business or go into the abattoir, which they finally did. Gradually new structures were erected, and more butchers joined the association, because it was then an advantage to do so.

In 1875, the city Board of Health passed a general order forbidding the carrying on the business of slaughtering or rendering within the city limits. The effect of this order was to concentrate all such business at the Brighton abattoir, and the result is to-day an admirably-conducted abattoir, which is not a source of offense, and which is capable of supplying a city of over a million of inhabitants with meat.

During the first six months, to January 1, 1874, there were slaughtered at the abattoir 14,194 cattle and 150,000 sheep, or about one-third of the cattle and three-fourths of the sheep dressed for market in the vicinity of Boston. Since that time more new buildings have been erected and other appointments and improvements introduced, including a one-story building, 380 feet long, used as a storehouse for the fertilizer made from the refuse blood, bones, etc. Including the cost of the land, buildings, etc., the cost of the abattoir has been about \$700,000.

The slaughtering is done on a raised floor, above a basement story, for convenience in caring for the blood and offal, while trap doors in the floors are used to receive the heads, feet, hide, tallow, etc., which are wheeled into the rendering house. In most of the buildings the cattle are hoisted for dressing by steam power. Hot and cold water are supplied to each slaughter house. Connected with each house is a refrigerator, in which all cattle are placed after having been dressed. These refrigerators have hanging space for from 60 to 200 carcasses. As it is not the object of this gossip to detail the manner of slaughtering, rendering, etc., at the Brighton abattoir, we have merely given the reader some outline idea of the extent and capacity of the establishment. We will add, however, that the best portions of the fat evolved by the rendering process are tried out for making artificial butter; the shin bones are sold for knife handles, etc.; the hoofs are manufactured into various articles for use and ornament, and the offal removed from the stomach and in-

* An Account of Some Experiments with Portland Cement Concrete, Combined with Iron, as a Building Material, with Reference to Economy of Metal and Security against Fire, etc. By Thaddeus Hyatt. London: Printed at the Chiswick Press.

testines is carted away to be used as manure. All offal and blood are rendered and dried immediately, while fresh and untainted. Since the abattoir was fully established, there have been slaughtered about 300,000 cattle and 1,400,000 sheep, while the fertilizer has ranged from 1,200 to 1,500 tons a year.

Since the year 1876, the business in the several departments of the abattoir has materially increased. The arrangements for dressing all meats for the Boston markets and vicinity are now excellent. One improvement in particular, which is greatly appreciated by all who are connected with the abattoir, is the branch railroad, which connects with Faneuil-Hall station, and over which beef, hides, and tallow are constantly transported direct from the abattoir yards. Those familiar with this great slaughtering establishment know that the cattle, which are resolved into various things, are shipped mostly from the West; but sheep, which are slaughtered in large numbers, come from all parts of the North and West. During the year 1876 something like 66,541 cattle, 322,705 sheep, and 9,860 calves were slaughtered; and in 1877 the number of cattle slaughtered was 74,933, and sheep 274,872. No record regarding the exact number of calves slaughtered was kept, but probably the number will not exceed that of the previous year.

Respecting the help employed in the establishment, among other items we learn that 45 men are employed in the factory, 50 in the slaughter houses, and about 30 in the fertilizing department. Some 150 horses are also employed in and about the establishment. The hide trade at the abattoir has greatly increased during the last few years. The pay of the butchers varies, and is much larger than one would naturally suppose it to be in these times of business depression, when the prices for most kinds of meats run low. Their average pay per day is \$3 and \$5, depending on skill; and the factory men, as well as the majority of the other workmen, command about \$2 per day the year round.

Before the Brighton abattoir was established, the system of accounting the number of farm animals received at Boston was far from perfect, but perhaps none the less correct. From 1863 to 1872 the number of cattle received was 1,224,036, the number of sheep 3,950,900, and the calves aggregated 146,000, while the fat hogs figured up 1,746,000, pigs 181,000.

Closely identified with the Brighton and Watertown stock yards, the abattoir reflects, in a dead and dressed form, so to speak, one of the finest slaughtering establishments in the whole country. The animals received here were, perhaps, only a week or ten days before over a thousand miles away, westward mostly, in the midst of the flesh-producing region. A careful estimate of the population of the eastern cities shows that about 5,000,000 of people must receive their meat by car transportation, and that three-fourths of such meat must be carried 1,000 to 1,300 miles. The people of Boston and its vicinity, representing 750,000 people, are fed mostly in this way, and the abattoir at Brighton is the place where the animals are slaughtered. Banks, hotels, etc., are in the immediate vicinity of the abattoir, and drovers and others find no difficulty in pursuing their vocation here.—*Boston Cultivator*.

GLASS MILL STONES.

A RECENT contemporary contains an account of the invention by a Mr. Meissner, of Thorn, Germany, of mill stones made of crystal glass. The inventor was first led to the construction of glass mill stones by noticing that the finest wheat flour was produced by those French buhr stones which were of the most close and glassy texture and composition. The manufacture of these glass mill stones is conducted in a manner very similar to that of the French buhr, and is thus described by our contemporary: Eight equal-sized pieces of glass, containing nine cubic meters each, are used as nuclei; the center piece of granite is kept open at the eye and is bound to the outer form with cement. The glass mill stones are sharpened just as the French. Thus far the furrows have been cut with knife picks and the dressing has been done with pointed hammers; but the inventor is of the opinion that the furrows can be much more profitably cut with the diamond dressing machine. It is claimed that these glass mill stones do not wear away any faster than the French, and their producing ability, according to the inventor, with a run of 1-31 meter diameter (51½ inches), and a driving force of six-horse power, is 100 kilograms of flour per hour (about 220 lbs. avoirdupois), 50 per cent. of which is a fine grade, and the run in no case grinding warm.

Two pairs of glass mill stones are at present in use, one in Thorn and the other in Borkendorf, and the parties using them at the latter place report that they grind more easily and cooler and produce finer and lighter flour than the French buhr stones. The grist is said to be drier, much more woolly, and looser, and the hull is better and more thoroughly separated from the kernel. The special claim put forth for the glass mill stones would seem to be that they generate less warmth than buhr stone, and when running are almost cold; and with grist and middlings they really run quite cold. The invention is at least original and new, and as such will no doubt attract the attention of our American millers, who are at present so keenly alive to every improvement made in the machinery applicable to their business.—*Mill Stone*.

THE COLUMBIA RIVER TRADE IN TINNED SALMON.

WE have just been placed in possession of a series of facts and figures illustrative of the commerce in American preserved salmon, which, we believe, will be new to most of our readers. Although the trade in tinned salmon began some sixteen years ago, it has only attained to the gigantic proportions which we have now to record during the last four years, when the total output of the various fisheries was as follows: In 1873, 102,733 cases; in 1874, 291,021 cases; in 1875, 244,173 cases; and in 1876, 415,218 cases. In the latter year the trade in tinned, pickled, and smoked salmon represented the enormous take of 10,000 tons of fish! During last year the total shipments to the United Kingdom amounted to 210,348 cases, each case containing 48 tins, in each of which there is one pound weight of salmon. The remarkable fact of one ship, the British Army, landing at Liverpool 55,000 cases, representing 1,350 tons, of Columbia River salmon, was recently recorded in our own columns. The magnitude of this importation will be understood if we compare it with the annual produce of the commercial salmon fisheries of the River Tay. The quantity thus brought to England represents 3,024,000 lbs. weight, and, assuming an average weight of 10 lbs. per fish, we thus find that 302,400 individual salmon were required to make up the cargo of the British Army. At a supposititious price of 10s. each, which is at the rate of 1s. per pound (which price, however, is only assumed for purposes of comparison), the

value of that freight would amount to £151,200, or more than seven times the assessed salmon rental of the River Tay, which is *par excellence* the salmon stream of Scotland, assuming that rental to be at the present time £21,000. No statistics are published that would afford a clew to the annual take of salmon in any of our Scottish rivers; but fishery economists calculate that a number must be caught every year equal to the payment of three times the rental in order to provide for wages, machinery of capture, and admit of a sufficient profit to the lessee; in other words, salmon must be annually caught in the Tay to the amount of £63,000, which gives 126,000 fish, each of the weight of 10 lbs., and say of the value of 10s., as already stated, for the sake of comparison.

The question naturally arises, "Will this supply of Columbia River fish continue?" We shall endeavor to answer that interrogation presently; meantime we desire to state some interesting particulars of this newly-developed business, which, we believe, is becoming productive of freights to Glasgow ships. The trade of "salmon canning" on the Columbia River during the first six or seven years was of slow growth; the material was good enough, but a market required to be created. The first speculators in the article continued to ship large quantities, but the encouragement they received was of the slightest kind. Many cargoes were returned to those who shipped them, and others were sold at a loss; but the dogged perseverance of the pioneers of the trade was at length rewarded: the public in time took kindly to these canned fish, and now the demand is said to exceed the supply!

"Astoria," of romantic and historic fame—Astoria, in Oregon—may be said to be the headquarters of the commerce in canned salmon; and that town or city has recently taken a jump in the way of progress because of this new trade, and from being a station of the fur traders, and more recently a mere fishing village with the appendage of a couple of sawmills, it has rapidly become a place of importance, with great hotels and a newspaper. The Columbia River is a stream of great magnitude—probably as large as all the rivers in Scotland would be if they were to flow in one vast body of water—and, as the figures relative to the shipment of its fish disclose, it must be the home of millions of salmon. The trade in canned salmon has during recent years extended to other rivers than the Columbia, and flourishing "canneries" are at work on the Umpqua, Frazer, Rogue, and other waters; but for the present fishing for salmon on the Columbia is quite sufficient to engage our attention. Capture begins in the latter part of April and lasts to the end of July, embracing a period of three months. The fish are free to all who choose to take up the business of their capture, no rent or tax of any kind, so far as we know, being exacted. The article to be traded in being free, only the wages of the fishermen and the laborers employed in the boiling factories require to be paid, and, of course, the interest on the amount of capital sunk in the business must be taken into account. To set up a thorough-going "cannery" requires an expenditure of something like £10,000, indeed \$50,000 may be sunk with advantage in the salmon-curing business of Oregon. Before describing the economy of a "cannery" we must say something about the capture of the fish. For the purpose of comparison with our home fish, the Columbia River salmon have already been averaged at a weight of 10 lbs. each; but, as a matter of fact, those hitherto captured have been, as a rule, much above that size. It may be set down that while, as at home, occasional salmon are taken which weigh from 50 to 70 lbs., the great run of the Columbia River fish range from 15 to 40 lbs., and may be averaged overhead as twenty-seven pounders. The salmon of the Columbia River are taken in various ways, the proprietors of the canneries not being particular about the method of capture. Many of them are taken in weirs and in other fixed traps of various kinds; but the majority of the fish are secured by means of a kind of purse net, the meshes of which are 8½ inches, so that very small fish are judiciously permitted to escape capture, the larger salmon being the most productive and the easiest to manipulate. The fishermen who contract to supply a cannery, with their assistants, start a little before sunset to their various stations. Large concerns keep a steam-tug, capable of hauling after it a considerable number of boats, which are left at points of the river agreed upon—a method of working which economizes time, especially when the wind is unfavorable. Much skill is required to work the kind of nets which are used. New hands require to serve a considerable apprenticeship before they become anything like successful; but most of the old stagers are certain and keen killers, and will fill their boat while a greenhorn at the business will only have netted a few fish. There are various kinds of salmon in the Columbia, some of which are not so much esteemed as others. At the canneries the "white salmon," so-called, is worthless; so also is a variety called "the hook bill;" then, again, a variety taken in the Willamette River, at Oregon City, is excellent when eaten fresh, but it does not can well, from its lack of oil. Doubtless, if we could obtain specimens of these fish we would find them to be of one breed, but in different stages of growth; but we are at any rate unable to recognize them scientifically by their local names. The fishermen work all night, and in the morning they either return direct to the cannery, if the wind is favorable, or they deliver their fish to the collecting boat belonging to the concern for which they fish.

As has been stated, a considerable capital is required to found one of these concerns. Some of them are running on money borrowed for the purpose at the rate of 24 per cent. per annum! Canneries, as a general rule, are so planned as to protrude upon the water, and with this view they are so far erected on piles. There are good reasons for this, the first of which is that the receipt of the salmon is rendered easy; secondly, the cases can be more readily sent on their way to the freight-bearing ships; and thirdly, the water is an admirable scavenger, which carries away all the *débris*, asking no questions. The best canneries are erected in the form of a horse-shoe or circle, so that no space is lost; and also that labor may be better economized, both ends of the horse-shoe abut on the river, and the newly-caught fish taken in at the upper point are sent out at the lower end ready to be forwarded to Europe. The course of work is well economized, and largely performed by "John Chinaman," without the aid of whom the trade would never have reached its present dimensions. The skilled fishermen only are white men, natives of the place, and familiar with the work of fish-capture, but the Chinese laborers are so invaluable that none of the cannery proprietors would exchange them for white men. Each cannery is complete in itself, has its own sawmill and carpenter's shop, and also makes its own tins. The plant of a cannery includes its site, and, of course, the materials of which it is made, as also troughs, tools, and benches for the operatives; a steam boiler for cooking the fish; tin, solder, paint, boxing materials, and a numerous

list of odds and ends. The boats and nets, and other machinery used in the capture of the fish, are also, as a rule, a portion of the stock in trade. In addition, there are wooden houses for the laborers, stables for horses, pigsties, and other conveniences. Four-fifths of the persons engaged in a cannery are of Oriental origin, and the Chinese like to live by themselves. It may be asserted that from the moment the fish are delivered at the concern till they are ready for shipment no hands but those of the Chinese touch them.

As the fish are landed from the collecting boats they are piled up within handling distance at the dressing tables; a hose able to throw a strong spurt of water cleanses the heap, and then the fish are laid out in long rows behind the men who act as dressers. One of these dressers seizes a salmon by the gills and lays him out on his table; in a twinkling the fish is decapitated, his tail and fins cut off, and an incision made in back and belly. The intestines of the fish are then removed, the first man finishing his work by throwing the carcass into a tank partially filled with water. Man number two washes, cleans, and scrapes the fish at or in his tank, and then passes it on to man number three, who perfects the operation of cleaning. The salmon is now ready to be cut in pieces: for this purpose several are laid in a trough, and by means of a crank are operated upon by knives, which divide them into the requisite lengths. A fifth Chinaman then operates upon them with great dexterity, cutting them longitudinally at a pace that is fearful to behold. As the slices accumulate they are carried off in baskets to another set of men, to be placed in the cans. It is needless to say that the salmon, rapidly as it has been operated upon, has all been manipulated according to a plan previously laid out. The pieces are so cut that they exactly fit the tins into which they are packed, the thick and the thin of the fish being deftly put in in alternate layers, a little spoonful of salt having previously been placed in each can. As has been stated, the cans are made on the premises in the necessary quantities and with astonishing rapidity. So soon as they are filled to within a quarter of an inch of the top the covers are soldered on, so as to make them ready for the cooking-house. Arranged on frames, containing ten dozen each, the filled and closed cans are lowered into a tank filled with steam, and large enough to hold 600 cans. After remaining an hour in this steam-bath they are then tapped with a very sharp instrument and allowed to "breathe" or "blow off," which simply means that the air with which they are filled is allowed to make its escape. The next process is to place the tins of salmon in a bath of boiling salt water for a period of two hours. After being taken from this boiler they are allowed to stand till they become quite cold, when they are examined with care to see if they have assumed the proper shape. If concave the tin is passed on to the painter to be finished; if curved, then it is condemned as being unfit for exportation. In some canneries the filled tins are rapidly dipped in a composition with the view of still further keeping out the air; in others they are only painted on their ends. After being labeled they are then packed in the boxes in which they are to be exported, previous to which each can is thoroughly sounded to know if it is all right; if it emits the proper ring—and the ear of an expert workman speedily detects a flaw—then it is ready for the market. Every ambitious workman is anxious to have as few "swelled heads" as possible.

Preparations for the work of curing begin in the canneries about April 1, and as the season is a short one it is requisite to make hay while the sun shines, or, as it must be said in the case of this trade, while the salmon are running; and from the middle of the month the work is carried on at a high-pressure rate of speed, and by means of the division of labor which we have indicated, as many as 25,000 cases of four dozen tins can be prepared and filled by a gang of seventy-five men. Such an establishment requires fifteen fishermen, each of whom has an assistant. The fishermen work by contract, and they have now become an important factor in the business. Some years ago the fishermen only charged 20c. for each salmon they supplied, whether it were large or small. With the advancing prosperity of the trade these necessities of its existence increased their charges to 25c., 30c., and 35c. respectively, and last year they demanded and received 50c. The cannery proprietors had previously resolved that they would not pay more than 35c., but the fishermen carried the day. It is not impossible but that this year a further rise may take place, the fishermen having their own views as to what remuneration should be paid to them. Half a dollar is not a large sum to pay for a salmon weighing 27 lbs. Salmon at 1d. per lb. weight look marvelously cheap, but the heads of the trade assert that 1d. added to the price of each can means a large falling off in the business. The tinned salmon yield, or have recently yielded, \$6 a case landed in Liverpool—that is, 25c. for forty-eight cans of 1 lb. each. The retail price of the commodity averages about 1s. per lb. in Great Britain, and it is largely sold in Glasgow and other Scottish cities and towns.

We must now consider the question of how far this large trade in salmon has affected the supply and the breeding power of the Columbia River. The numbers of salmon reported as taken annually for some years past would appear incredible were they not vouched for by Messrs. Gillon & Co., of Leith. A New York paper stated some months ago that 12,000,000 salmon had been taken from the Columbia in one year! That statement is, however, an obvious exaggeration; pounds weight must, we think, have been meant.

It must be borne in mind that the fish are all captured on their way to the spawning ground, and that consequently the number of eggs deposited must annually be decreasing, and the supplies of future years thereby endangered. That an impression has already been made on the breeding stock of the Columbia River we have the best means of knowing. Professor Stone, one of the Fishery Commissioners of the United States, having proceeded to Astoria to make inquiries on the subject of the decreasing supplies, and the proprietors of the canneries having subscribed a sum equal to £5,000 to aid in the propagation of salmon. The area of the Columbia River, it may be mentioned, is of great extent, embracing, as it does, 283,400 square miles, and the fish run up the stream to a distance of 400 miles from the sea. In November last it was known that the supply of salmon for the present year would be far under that of last year, which, again, was less than in the season of 1876 by nearly 100,000 cases. The shipments to Europe are also affected by supplies sent to the Australian colonies; 62,482 cases were sent there last year, and the demand is on the increase. Contracts for the present season were offered to the canning houses at an advance of twenty per cent. on former prices, but these offers were declined.

This story of the Columbia River is the old story which has been told of every salmon stream we ever heard of. First, the stock of fish is exhausted by over-fishing, and then money is expended right and left to try and repopulate the

river! "After the steed is stolen be careful to lock the stable door," is a proverb that well illustrates the want of that thrift and foresight which results in the killing of the goose for the sake of its golden egg.—*Glasgow Herald*.

ROBERT COLLEGE, AT CONSTANTINOPLE.

By REV. GEORGE WASHBURN, D.D.

ROBERT COLLEGE was founded by C. R. Robert, Esq., of New York, and its first President was Rev. Dr. Hamlin. It opened in 1863, and occupied its present buildings in 1871. Mr. George H. Corliss, of Providence, R. I., Mr. Remington, the rifle manufacturer, and others have since contributed to its endowment; \$5,000 has just been contributed in Boston to aid its students, who are reduced to poverty by the war. It is now under the charge of Rev. George Washburn, D.D.; Rev. A. L. Long, D.D., a distinguished scholar of the Methodist Church; Professor Grosvenor, a graduate of Amherst; Professor Savage, of Dartmouth, and twelve other gentlemen of various nationalities.

It has been in every way a success. Before the war it had 230 students, and its income from them was enough to pay all its current expenses, including salaries. Even now it has 118 students, in spite of the terrible distress caused by the war.

It has made a deep impression upon all the nationalities of the empire. They never cease to look upon it with wonder, and to speculate upon the probable motives which led Mr. Robert to establish it. It has not only stimulated the government and the people to new efforts to improve their own educational system, but has prompted individuals to contribute large sums to found and improve native institutions. Many of its graduates have become teachers in these native schools.

The Armenians, Bulgarians, and Greeks constitute the greater part of the students; but twelve other nationalities are represented, and almost as many religions. Contrary to the fears of many, no difficulties have ever occurred between the students growing out of national or religious difficulties. In the studies of the course these students compare favorably with those of the best New England colleges, though they lack that unconscious education which American boys receive all through their youth in the churches, the lecture-room, the newspaper, and in a thousand other ways.

Many difficult problems have come up for solution in determining the course of study, which was intended to be similar, or at least equivalent, to that of New England colleges. For example, the question of the study of the ancient languages: it is not a simple question, as it is in America. The question must be answered in Constantinople very much as it would have been in the tower of Babel, if it had been proposed to add one more language. Fifteen ancient and modern languages are and must be taught in the college, and if the students were left to their own choice they would study them all and nothing else. The language of the college is English. Every student must learn this thoroughly. Each must take a thorough course in his own language, and in the ancient language from which it is derived. All need French and German, and as Turkish is the government language, all should learn this. This cannot be thoroughly learned without the study of Arabic and Persian.

In view of these facts, no one can be surprised that ancient Greek is not obligatory, and that Latin is studied only two years. If the students had not a special aptitude for learning languages they could never get through the present course in the five years allowed. The Armenians and Bulgarians are good mathematicians, but the Greeks are not. The natural sciences are new and fresh to all the students, and many become deeply interested in them. Philosophical studies excite still more general interest, and the mental development of the students is more marked and rapid in connection with these studies than any others.

The college has a valuable library of 6,000 volumes, and every effort is made to cultivate the habit of reading and independent research. As it is the first acquaintance of the students with a general library, they need to be taught how to use it, and their interest in it needs to be carefully developed. This is generally a work of two or three years.

These facts have been mentioned simply as an evidence that Robert College is an object of interest from an educational as well as from a philanthropic point of view. It has been no easy or simple matter to establish an American college in the midst of the decaying civilization of the East, and, having established it, to secure the confidence and respect of the many nationalities of the Ottoman Empire. This has been done, and the college has stood unshaken through the wars and tumults of the past two years. It is to be hoped that England and Russia will not aggravate the distress of the people of Turkey by continuing the war. If, however, they commit this crime, the college will not be closed, but continue to suffer with the people.—*New England Journal of Education*.

JOACHIM JOHN MONTEIRO.

A FEW days ago we recorded the melancholy fact of the death of this enterprising African traveler. We have since been favored with a few particulars of his life and labors, which appear to us to demand more than a passing word of recognition. His work on "Angola and the River Congo" (Macmillan, 1875) is still fresh in the mind of the public, and has been made doubly interesting through the recent travels of Mr. Stanley. Mr. Monteiro commenced his scientific education at the Royal School of Mines, under the late Sir H. De la Beche, and at the College of Chemistry under Dr. Hoffmann, at both of which places he obtained first-class honors. His first visit to Angola was in the year 1858, when he went to work the Malachite deposits at Bembe, in that province, and also the blue carbonate of copper. This obtained honorable mention in the International Exhibition of 1862. It was while working these deposits at Bembe that the King of Congo came down to pay a visit, and was received with all honors. A very curious letter from this king, asking for a "piece of soap to wash his clothes with," is now in the possession of the British Museum.

It was during his stay at Bembe, and while exploring the country round, that he discovered that the fiber of the *Adansonia digitata* was so valuable for the purposes of making paper, but it was not until 1865 that he returned to the coast for the purpose of developing this extraordinary discovery. He continued to work this enterprise for many years, so as to fully establish the claim of this fiber to being the most valuable natural product for paper-making. Paper made exclusively of this fiber is scarcely to be distinguished from parchment, and it is owing to this remarkable quality that a small percentage of the fiber enables the manufacturer to

utilize substances which would be otherwise useless. While at Bembe Mr. Monteiro procured some of the most interesting birds, and although the results of his first collecting were perhaps not so important in regard to novelties as those made later on, the value of this, our first contribution to the avifauna of Inner Angola, will never be underrated by ornithologists. In September, 1866, he accompanied Mr. A. A. Silva, the United States Consul, on an ascent of the River Quanza for the purpose of opening up the country to trade, and the natives were greatly astonished at their first experience of a "smoke vessel." In April, 1873, he had the brothers Grandy as his guests at Ambriz, and supplied them with beads and goods for the arduous undertaking assigned to them by the Royal Geographical Society, of endeavoring to discover the sources of the River Congo, and of aiding Livingstone should he cross the continent and make for the West Coast. Mr. Monteiro accompanied the brothers Grandy five days inland. He explored the Congo as far as Porto da Lenho, in a steamer belonging to a Dutch house at the mouth of the river; and it was while on this expedition that he met by appointment, and at their desire, nine kings of Boma, whose curiosity he greatly excited by being the owner, as they said, of the first white woman, his wife, they had ever seen, and from her hand the kings were greatly pleased to receive a "dash" or present.

Mr. Monteiro was honored with the friendship of Dr. Livingstone, who strongly desired him to accompany his expedition as mineralogist, but this wish he could not accede to, owing to his engagements in working out the fiber-scheme on the West Coast. His researches in the natural history of Angola have been of great importance to science. Among the many botanical specimens which he forwarded to England may be mentioned the plant and flowers of *Welwitschia mirabilis*, from which Sir Joseph Hooker was enabled to compile his splendid monograph of this extraordinary plant; besides many parasites, orchids, etc., which have been named after him. Perhaps the most interesting animal discovered by him was the beautiful little lemur (*Galago monteiroi*), and the well-known chimpanzee, "Joe," which lived so long in the Zoological Gardens, was also brought to England by him. His second collection of birds was described by Dr. Hartlaub in 1865, and contained many new species, the most interesting of which were a Hornbill (*Tockus monteiroi*) and a Bustard (*Otis picturata*), while he also procured a living specimen of the splendid Plain-tailed Cuckoo (*Corythaeus livingstoni*) discovered by Dr. Livingstone in the Zambesi country.

Mr. Monteiro's eighth, and, as it was unfortunately proved, his last visit to Africa, was one to Delagoa Bay, and here he expired, after a severe illness, on the 6th of January last. In company with his wife, who contributed so largely to his natural history collections, at which she worked with equal courage and zeal, he had set himself to develop the mineral and natural products of that Portuguese possession, and had already sent to England many valuable specimens, when his untimely death put an end to all his projects. There can be no doubt that Angola, to the elucidation of the natural history of which Mr. Monteiro contributed so largely, still presents a fine field for the collector, and it is to be hoped that some one will be found who will continue the researches so well instituted by the deceased traveler.—*Nature*.

DETERMINATION OF THREADS OF FLAX AND HEMP.

On untwisting raw flaxen and hempen threads, we do not at first notice any difference between them and the original fiber, but under the microscope the elementary fiber becomes observable, and researches in this direction we owe to a German, Mr. Ludicke. Independent of the paper manufacture, in which the length of fiber, according to Aimé Girard, must be at least fifty times its diameter, there is no industry besides the textile for which the length is of material importance, and for the spinner it cannot but be of advantage to determine the number of yards which a certain weight of fiber—say, a gramme—can furnish, or, in other words, how fine the same may be drawn out. To ascertain this, Mr. Ludicke experimented on different varieties of fiber, with the following results:

	Meters per gramme.
Hemp, common, coarse quality.....	4.441
" Manila, medium quality.....	5.670
" Italian, finest quality.....	6.006
Belgian flax, finest quality.....	7.157
Jute.....	8.280

In order to separate the jute under the microscope, it was necessary to employ chromic acid, mixed with a little sulphuric acid. It is remarkable that jute, from which only lower numbers are spun, and the fibers of which could only with great difficulty be mechanically separated, should give the greatest length. With the exception of jute, whose use will always be restricted on account of its liability to separate under the action of water or moisture, there is thus no vegetable fiber in which so great a fineness can be obtained as with flax.

BLEACHED AND WASHED LINEN AND HEMP THREADS.

WHEN the natures of flaxen and hempen threads unraveled from old cloths are investigated under the microscope, one important point becomes noticeable, viz., in flax (a fiber which, as we have already remarked, contains a number of knots), while in water, the fibers become silky, highly flexible, and completely detached; with hemp, however, there are still a great number of unseparated parts, or bundles, formed by the fibers adhering together. In flax, the points seem very much bruised; they are replaced by a kind of pencil formed of fibers, which themselves are split and often considerably divided one from the other. In hemp a great number of the ends are still intact, and retain their primitive forms. This leads to the conclusions—1. It is to this peculiar constitution of flax that the use of lint in preference to cotton in surgery is due, and that the theories on this point, believed in generally, are erroneous. It is said that flax is employed because its soft and rounded forms do not irritate the wounds as cotton would. But what is less round than flax? We explained in our first article that its form is polygonal in the sections, and that its ends are very sharp. The truth, however, is that hard though they may be, the finely divided fibers of flax absorb pus and other secretions better than any other more rounded or hollow substance. Others say that flax is open at the ends while cotton fibers are completely closed, but against this must be set that it is almost established that flax is pointed at the ends, and, as far as can be seen, but little, if at all, open at its extremities, the fact being that it is simply more spongy and more porous than cotton. 2. That for underclothing

which is to be ironed hemp should never be used, but, as far as durability is concerned, it may be of advantage to use it for articles which have only to be washed, such as sheets, etc. In ironing the flax fibers are flattened, which treatment they withstand without injury, assuming easily almost any shape which is given them. In hempen fabrics the filaments are bundles of fiber, and if forcibly bent, the latter being surrounded by gum, are finally broken. 3. As regards durability, goods of linen or of hemp should always be preferred to such manufactured from a mixture of both; in the latter the flax fiber gets thoroughly disengaged after several washings, and also becomes quite cut by the hemp fibers, which latter, being in rigid and compact bundles, only separate under unusual circumstances.

MIXTURES OF FLAX AND HEMP.—In order to ascertain the mixture of these two materials, the following process is recommended: Having set the microscope to the strongest objective, the ocular micrometer is replaced by a small sheet of glass, containing two series of parallel lines, spaced at equal distances, each series intersecting the other at right angles, thus forming a number of small squares, the glass plate being moved in such a manner that each square corresponds nearly to a small portion of the fabric. On a piece of paper divided in two columns, one for hemp and one for flax, is noted the quantity found of each of the two substances in every square. In adding the column the proportion of the two textiles in the web under examination is thus pretty accurately determined.

A SENSITIVE GELATINE EMULSION PROCESS.

To such of your readers as will carry out every point faithfully to the letter I can hold out full hope of success. I shall keep nothing back, so that it will lie with them to get the same rapidly. We shall have all the materials in common excepting one, and that is the washing water.

First, then, the light. I have tried "warranted non-actinic" and "tested by spectrum analysis" glass, and can print transparencies through two thicknesses of such in about thirty minutes. Procure, therefore, from a glass merchant, some of the darkest shade of ruby, and use two thicknesses for daylight and one for lantern. This is positively necessary, as we are to use a very powerful developer upon a very sensitive plate. If gelatine workers were careful on this point I think we should hear less of "organifiers" or "want of density" than at present. I never have any trouble on that score, because no actinic light having touched the emulsion, I can apply any amount of development without any danger of fog.

To make "assurance doubly sure," use a ruby-colored hock bottle, and with two eight-ounce decanter-shaped bottles made of test tube glass to stand heat—procureable at Rouch's, and, doubtless, elsewhere—weigh out for a ten-ounce emulsion—

Bromide of ammonium.....	7 grains.
Best nitrate of silver.....	11 "
Gelatine.....	20 "
Distilled water.....	1 ounce.

Use Nelson's "No. 1 photographic gelatine," for with the opaque sixpenny packets you can have irregularity, red fog, and frilling. Place aside four ounces of water for the bromide and two ounces for the silver; dissolve the bromide with heat in one of the test bottles in one or one and a half ounce of water; pour into the hock bottle, swirl out the test tube with the remainder of the four ounces set aside for the bromide, and also pour in. I do it by heat to insure all being dissolved, as it does so very slowly after the gelatine is inserted. The four ounces of solution being now almost cold, add the gelatine, shake up well, and place in two or three gallons of water at 90°. I use a fish-kettle with lid. In two hours the bromized gelatine will, after well shaking, be quite liquid, and also nearly at 90°. Now dissolve the silver in the other test bottle by heat in one ounce of water, cool to 90°, and pour in; use the remainder of the two ounces set aside for the silver to swirl out, heat to 90°, and pour in. By being so particular we get regularity and are able to mix the plates of different batches, which is a great boon. Shake the emulsion very briskly and replace in the kettle for two, four, or seven days, according to rapidity required. The temperature should never be over 90°; if you do not let it exceed that you will not have red fog. "Cosy" it up with flannel, and it will not lower many degrees during the night. I, however, use a stove two feet across and place it on that; a faint gas jet below keeps it always at 90°. I shake up every twelve hours. If washed in two days the emulsion is rapid and dense; in four days more rapid and less dense—quick enough for any drop-shutter known, when developed as below. Some that I kept for seven days, with drop-shutter and dull February morning pebbles close to the camera, were perfectly exposed. The negative was thin under ammonia, but bore intensifying to any extent.

Cool the emulsion in a bottle not smaller than a Winchester quart, and wrap it up in brown paper to exclude all light except the lip of the neck. Let an India-rubber tube go quite to the bottom of the bottle to stir away those layers of water which, on account of greater specific gravity by reason of the salts they now contain, would otherwise remain there. Wash for twelve hours; a dribble is sufficient. Upon melting you have eight or nine ounces of emulsion; add three-quarters of an ounce of pure alcohol, heated to 90°; fill up with water (also warm) to ten ounces, and coat. The plates should be only lukewarm, or you will have red fog. Expose a few plates with small stops—instantaneously; gradually increase the size of stop or length of time.

To develop I use for $6\frac{1}{2} \times 4\frac{1}{2}$ one cobalt tray $8\frac{1}{2} \times 6\frac{1}{2}$ for ammonia, one ditto for silver, and one 10×8 to cover over either during development to keep all light off. After soaking a minute pour the following quickly along that side of the tray which is not occupied by the plate, and by rocking the dish suddenly send it sweeping over the plate (it is developed in five to twenty seconds):

Pyro.....	1 grain.
Bromide.....	none.
Pure undiluted liquid ammonia.....	1 to 10 drops.
Water.....	1 ounce.

Do not flood with pyro. first or you will render the plate slower, nor add more pyro. or you will again slow the plate, and, moreover, have it too dense. If the exposure has been sufficiently short you should have a dense negative with bare glass for shadows almost as soon as the developer has covered it. A 10×8 Dallmeyer triplet, with drop-shutter, would require in good light (say) four drops of ammonia; if bad light, eight to ten drops. A six-inch single lens, in good light, would require (say) one drop; in bad light, four drops.

If much ammonia be used and the plate be not developed in half a minute, make fresh developer and wash the plate.

Being now in possession of some extra sensitive plates, put one in a thick book, and, having placed it five or six inches from your ruby glass window or lantern, draw out the plate one-third for a few minutes; again draw it out further one-third more for a short period. You will then have the film in three divisions, as it were—one portion not having been exposed to the red light and the other two portions having had different exposures. Now develop, and use (say) three drops of ammonia. If your light be still at fault the exposed portions of the plate will fog; in that case use another thickness of ruby glass.

Finally, I need scarcely wish success to those readers who desire the same rapidly as my negatives alluded to in your last issue exhibit, because success is certain, provided no modifications of the foregoing particulars are made.—CHARLES BENNETT, in *British Journal of Photography*.

PHYSICAL SOCIETY, LONDON.

Transmission of Vocal and Other Sounds by Wires.—W. J. MILLAR, C. E.—The author was led mainly by a consideration of the manner in which sounds are conveyed through walls and partitions, to make an extensive series of experiments on this subject, from which he concludes that conversation can be carried on at considerable distances by simply employing stretched wires provided with suitable vibrating disks. In one experiment two copper wires were attached to points on a telegraph wire 150 yards apart, and breathing, singing, etc., were distinctly audible; by stretched wires extending through a house and provided with mouth and ear pieces in the several rooms, conversation could be carried on without difficulty. The materials employed for terminals were very varied, and the vibrating disk, whether metal, wood, India-rubber, etc., was generally formed as a drum head, the wire being fastened at its center. The volume of sound appears to be greater with a heavy wire, but in all cases it requires to be stretched.

President Adams referred to the experiments of Wheatstone on the conduction of sound by vibrating bodies, especially long wooden rods. He mentioned that in 1856 a performance was given at the Polytechnic, at which numerous experiments connected with such conduction were exhibited. Some years ago M. Cornu, in conjunction with M. Mercadier, made experiments which showed that vibrations can be transmitted along a copper wire, and rendered visible at the distant end on a rotating blackened drum. The free end of the wire was attached to a piece of copper-foil fixed at its base, and provided with a point which left a clear trace on the drum when the distant end was attached to, say, a vibrating tuning-fork. By connecting such an arrangement with different instruments, and varying the players also, M. Cornu has ascertained the form and extent of vibration corresponding to each. The arrangement adopted by him was exhibited by Prof. Adams, and in conclusion he referred to a passage in Hooke's "Micrographia," which clearly showed that he was aware of the facility with which sounds can be transmitted to a distance by solid bodies.

Mr. W. H. Preece described some experiments made in September of last year by Mr. A. W. Heaviside and Mr. Nixon at Newcastle-upon-Tyne on this subject, from which they conclude that the method might certainly be applied with success to the transmission of speech within a building. They find that a No. 4 wire gives the best results. The terminals were wooden disks about $\frac{1}{4}$ in. thick, and to these the wire was attached "end on," but speech could be distinctly heard by laying such a disk on any intermediate point of the wire. When the wire was particularly still, speech was audible up to 200 yards.

Thermo-electric Currents in Wires Subjected to Mechanical Strain.—G. W. VON TUNZELMANN.—The wire of iron, steel, or copper was stretched vertically between two cans, which could be maintained at different temperatures. It was fixed in the base of the lower can, and held in the upper one by a clamp attached to the shorter arm of a lever, to the longer arm of which the stretching weight was applied. The free ends of the wire were joined to copper wires, which led to the Thomson galvanometer, these junctions being covered with cotton-wool. He has succeeded in reconciling the contradictory conclusions arrived at by Sir W. Thomson and M. Le Roux, for whereas the former only used moderate strains, the latter worked near the breaking limit, and the author finds that if the weight be gradually increased the direction of the current changes, and hence these two authorities found the currents to flow in opposite directions. A great number of experiments were made, and from them it is evident that on applying a strain the deflection does not immediately attain a maximum, but it gradually rises for about eight minutes and then gradually falls, attaining a stationary point at the end of about 13 minutes. Experiments in which the weight was rapidly put on and taken off led him to conclude that, besides the permanent there is a transient effect produced by the strain, and this latter only he considers to be due to a change of molecular state.

Lissajous' Figures.—Prof. Adams exhibited a simple arrangement for projecting Lissajous' figures on to the screen, which had been made by his assistant, Mr. Furze. It consists of two strong straight steel springs, fixed in separate heavy iron frames, the one horizontally and the other vertically. The latter carries at its end a double convex lens, and the former carries a black disk perforated with a small hole, and is so mounted that its length may be varied as required. If now the disk be placed before the lamp and the point of light be focused on the screen by means of the lens on the vertical spring, the two springs may be caused to vibrate, and the spot will describe a figure corresponding to their relative rates.

Prof. McLeod referred to an analogous arrangement in which the spot and lens are replaced by two slits in black disks at right angles to each other.

Colloids and Crystalloids.—Dr. Guthrie exhibited an experiment to show the behavior of colloids and crystalloids in relation to electrolysis. A solution of gelatine was colored with litmus, made acid, and mixed with sulphate of soda; two platinum poles of a six-cell Groves battery were then immersed in it, and the gelatine was allowed to set. The mass became comparatively clear round the positive pole and red and blue clouds were formed, which met across a space of about $\frac{1}{4}$ inch in three-quarters of an hour. The relative advance of the ions was indicated by the brightening of the litmus round one pole and by the blue coloration produced at the other.

Mr. W. ACKROYD points out in *Nature* that in the human ear the drum is inclined to the axis of the ear at an angle of 46°, and suggests that this arrangement should be imitated in telephony. Mr. Newth, South Kensington, finds his telephone to work best when he speaks into it in a slanting direction.

SOUND COLOR-FIGURES.

By SEDLEY TAYLOR.

THE great interest excited by Prof. Bell's telephone and Mr. Edison's phonograph, in which an elastic disk or membrane faithfully takes up the highly complex vibrations due to sounds of the human voice, has directed renewed attention to the optical methods hitherto employed in studying the motion of resonant media. These have, in important instances, been based on observations of the secondary effects produced by sonorous vibrating bodies. Thus Chladni watched the behavior of sand strewn upon sounding plates and membranes; König that of gas flames acted on by aerial vibrations. The present article describes an analogous method depending on the colors reflected from slightly viscous liquid films when thrown into sonorous vibration.

The ordinary phenomena called the "colors of thin plates" are sufficiently well known, but a short description of them, taken from a standard work on Physical Optics, may still not be out of place here as a reminder:

"If the mouth of a wine-glass be dipped in water, which has been rendered somewhat viscous by the mixture of soap, the aqueous film which remains in contact with it after emersion will display the whole succession of these phenomena. When held in a vertical plane, it will at first appear uniformly white over its entire surface; but, as it grows thinner by the descent of the fluid particles, colors begin to be exhibited at the top, where it is thinnest. These colors arrange themselves in horizontal bands, and become more and more brilliant as the thickness diminishes; until finally, when the thickness is reduced to a certain limit, the upper part of the film becomes completely black. When the bubble has arrived at this stage of tenuity, cohesion is no longer able to resist the other forces which are acting on its particles, and it bursts."—(Lloyd's "Wave-Theory of Light," page 100.)

If the film, instead of remaining at rest, is thrown into sonorous vibration, totally distinct color-phenomena instantly present themselves. A rough idea of their general character may be obtained without the aid of any apparatus, as follows:

While washing the hands, after getting a good lather, a film can easily be formed between the thumb and forefinger of one hand held in a horizontal plane; the other hand supplies an extemporized tube through which a note can be sung, and so vibrations caused to impinge on the lower surface of the film.

If this is done the reflected colors will be seen to be in regular motion, and, in particular, a number of small eddies of color will be observed whirling about fixed centers of rotation. Steady colored bands may also be sometimes recognized, but with much greater difficulty.

Fixed bands and stationary vortices form, in fact, the constituent elements of all the sound color-figures obtainable by film reflection.

In order to study these in detail a specially arranged apparatus is, of course, requisite. I have found the following give excellent results:

An L-shaped cylindrical brass tube is permanently fixed upon a wooden stand, with its two limbs vertical and horizontal. The vertical limb terminates in a narrow flat circular ring. The open orifice of the horizontal limb is fitted into a caoutchouc tube of equal bore, ending in a trumpet-shaped mouthpiece. For the purpose of supporting the films operated on, I use a series of metallic disks pierced with apertures of various shapes and sizes. On covering one of these, by means of a camel-hair brush, with some weak solution of soap,* a film of considerable durability will be formed upon it. The disk should first be held in a vertical plane until the colored bands have begun to show themselves, and then laid gently upon the horizontal ring prepared for its reception. The observer places himself so as to get a good view of the assemblage of colors reflected by the film, and the instrument† is ready for use. Sounds of tuning-forks, whistles, organ pipes, etc., or notes of the human voice have only to be produced near its mouthpiece, in order that their vibrations may be conducted to the film, and the resulting phenomena observed.

The forms thus presented are of endless variety and great beauty. They almost invariably include both motionless curvilinear bands of color very regularly disposed and also a system of color vortices revolving about fixed nuclei. The contrast between the steady and moving portions of the figures is always very striking, and the effects of changing tint which accompany the progressive thinning of the film gorgeous in the extreme. When the moment of its dissolution is close at hand, patches of inky blackness invade the field, until at last there is sometimes nothing left but an ebony background, with here and there a few scraps of light, either at rest or still flying round their former orbits, the remnants of fixed bands and whirling vortices.

That the results obtainable by the mode of experimenting above described are likely to present a practically endless variety of form will be at once obvious from an enumeration of the several causes which may influence the assemblage of colors reflected at a given instant from a given film acted on by the vibrations of a given sound. These are: 1. The shape of the film; 2. Its size; 3. Its consistency; 4. The intensity of the sound; 5. Its pitch; 6. Its quality; 7. The direction in which the sound-vibrations take place with reference to the plane of the film.

It thus appears that each color-figure observed may be a function of not less than seven independent variables; and on experiment this proves to be the fact. An alteration made in any one of these elements, while all the rest are kept constant, produces a corresponding change in the appearances observed. The intensity of the sound does not, it is true, affect the form of the figure, but controls the rate of its vortical motion; the louder the sound the more rapid the rotation of the color-whirls. All the other elements act directly on form.

It is evident from what has preceded that an attempt at anything like a general classification of sound color-figures would afford materials for a considerable volume. All that can be done within the present narrow limits is to draw attention to a few points of special interest.

Dependence of Form on Pitch.—This is perhaps most distinctly shown by alternately stroking with a resined bow two mounted tuning-forks of different pitch, the open ends of whose resonance-boxes are placed close to the mouth-piece of the Phonoscopes. As long as the same aperture

* Castile soap, I find, answers extremely well.

† It is manufactured and sold under the title of the "Phonoscopes," by S. C. Tiley & Co., Philosophical Instrument Makers, 172 Brompton Road, S. W.

‡ A reader of *Helmholtz* will see that I might have added an eighth element by taking into account differences of phase among partial tones, which, though inoperative on quality, directly affect mode of resultant vibration.

is used, and the film kept at one degree of consistency by frequent renewal, each note will instantly call forth its own color-figure for any number of alternations. This mode of experimenting has the advantage of giving perfectly steady and sharply defined figures. But the successive alterations of form due to changing pitch are more interestingly shown by singing* the diatonic or chromatic scale, on some single vowel, into the Phonoscopes. The complete change of figure consequent on perhaps but a semitone's alteration of pitch is often most surprising. It was these sudden kaleidoscopic bounds from one form to another which suggested the name given to the observing instrument. In general the complexity of the figure increases with the acuteness of the exciting sound. With low notes a comparatively simple arrangement of a few rings and pairs of vortices occupies the film. As the pitch rises, the separate parts of the figure diminish in size and increase in number, so that the whole field is covered with a regular pattern which is constantly growing more and more minute. With very shrill sounds the pattern can only be made out by using a magnifying-glass.

Effects of Quality.—These are easily observed by employing unison organ-pipes of different timbres, e. g., treble C's belonging to stopped and open diapasons, clarabella, and hautboy, respectively. By sounding them consecutively in the above order, figures rapidly increasing in complexity are obtained.

Prominent among differences of quality are those which distinguish vowel-sounds of the human voice sung successively on one and the same note. Marked corresponding differences of color-figure are recognizable in many instances, but I have not at present succeeded in extending the observation to all the European vowel-sounds.

Effects due to Direction of Vibration.—The best mode of observing these is to strike a tuning-fork, and hold it with one of its prongs close to the surface of the film.

By moving the fork it is easy to show that both the axis of symmetry, and to some extent also the form, of the color-figure thus produced, are dependent on the position of the fork with respect to the film, and therefore on the direction in which the exciting vibrations impinge upon it. The steady bands of a figure obtained by this method shift to and fro upon the film in obedience to the fork's movements, almost as though under a magnetic influence resident in its prongs.

Resultant Figures due to Combined Sounds.—If the sounds of two tuning-forks are separated by a considerable interval of pitch, say an octave, they will generate, when alternately applied to the same film, very different figures. When both are applied together there results a figure different from either of those due to each fork by itself. It is in fact a compromise between the two. In order to convince himself of this the experimenter should first get the forms of the component figures well into his memory by repeatedly producing them, and then watch the effect, on some one band in either figure, of mixing the two sounds in various degrees of relative intensity. Let us suppose that fork 1 produces figure 1, and fork 2 figure 2, respectively, and that a band in figure 1 is selected for observation. Then if fork 1 be struck sharply, and fork 2 weakly, the band will alter its form so as to exhibit a slight approach to the arrangement in the corresponding part of figure 2. As the note of fork 2 is more loudly sounded this approach will be more decided. If fork 2 is made preponderant the result will be the arrangement of figure 2 with some modification toward that of figure 1. The same thing holds good for the rotating portions of the figures. Complex color-flows are seen to result from a compromise between simpler component vortices.

Effect of Beats.—When two sounds of very nearly the same pitch coexist, slow fluctuations of intensity called "beats" are known to be produced. If a film is exposed to the simultaneous action of two sounds so related, the fixed parts of the resulting figure take up a swaying motion about their mean position, each complete oscillation synchronizing exactly with one entire beat. The vortices show, in general, an increased speed of rotation during one-half of each beat, and a diminished speed during the other half. But in particular cases a bolt forward every alternate half-beat seems to be followed by intermediate quiescence, or the direction of motion may be actually reversed, so that a vortex rotates positively during one-half beat and negatively during the next.

Representation of Dissonance.—When the beats become too rapid for separate recognition, and coalesce into the effect which we call discord, the color-figure presents a tremulous appearance, like that shown by the tip of a singing gas flame. Prof. Helmholtz has remarked how unpleasant is the impression which a flickering light makes upon the eye, and pointed out its analogy to the effect of rapidly intermittent sounds on the ear. In the present experiment, acoustical and optical dissonance are exhibited in a direct and interesting connection.

As the phenomena described in the above article admit of such facile reproduction in all their beauty of form and splendor of hue, I have thought it needless to attempt illustration by diagrams, which could convey but an inadequate notion of the former, and none at all of the latter.—*Nature*.

MILITARY TELEPHONES.

THE telephone has been adopted into the outpost system of the Russian army. The line employed is a light cheap cable, which can be laid over any kind of ground by one man. It is in lengths of from 400 to 500 meters, this being the average distance between pickets and supports, and consists of two insulated copper wires. Each length weighs from 8 to 10 lbs., and costs about £3. The winding apparatus, together with two telephones, costs £1 more—total for each length, £4. Bad weather is not found to interfere with the working of the telephones, but noise, of course, does, and it becomes necessary to cover the head with the hood of a great coat to exclude extraneous sounds.

TELEPHONE IMPROVEMENTS WANTED.

In order to compare the intensity of sounds as given out by the telephone with their original intensity, M. Demogot, of Nantes, has experimented with two Bell telephones in an open field. He held one of these to his ear, while his son at a distance kept repeating the same syllable with the same intensity of voice into the second instrument. He compared in this way the sound heard from the telephone with that heard from the speaker, and calculated their relative intensities from the relative distances of their sources from his ear. When the telephone was held about 5 centimeters from his

* A pitch-pipe with a sliding piston may be substituted for the voice in this experiment.

ear, and the distance of the speaker was 90 meters, the direct and telephonic sounds were of equal intensity, and the ratio of the intensities at the source was therefore as 25 to 81,000,000; in other words, the sound transmitted by the telephone was only about $\frac{1}{3,240,000}$ of the sound emitted. Owing to the influence of the ground, however, the stations could not be considered as points in free space, and M. Demogot therefore alters this ratio to $\frac{1}{2,500,000}$. From the fact that the intensities of two sounds are proportional to the square of the amplitude of the vibrations, it follows that the vibrations of the two plates of the telephones were directly proportional to the distances, that is to say, as 5 is to 9,000 (centimeters), and that the vibrations of the receiving telephone are 1,800 times smaller than those of the transmitting telephone. They are, therefore, comparable to molecular vibrations. M. Demogot, without wishing to diminish in anything the merit of Bell's invention, concludes from these results that the telephone as a machine leaves much to be desired, since it can only transmit $\frac{1}{2,500,000}$ of the original work, and remarks that its results, so unexpected, are due rather to the perfection of the organ of hearing than to the perfection of the instrument.

LEAVES IN INTENSE SUNLIGHT.—**PROF. J. BÖHM.**—There is a maximum intensity beyond which the action of light upon vegetation is injurious. In such cases leaves are first bleached, then turned brown, and of a metallic luster, and finally destroyed. The under surface of leaves is much more sensitive than the upper.

NEW DIRECT-VISION SPECTROSCOPE.

By M. THOLLON.

The author states that it is distinguished by its small bulk, its lightness, and by the ease and precision with which the prisms are handled. Its dispersive power can be rendered equivalent to that of 15 to 20 prisms of 60°. On applying it to the light of the sun he has seen over the whole outline of the disk the brilliant rays of hydrogen and helium with remarkable distinctness.

CLUB-FOOT—SPINE CURVATURE—HIP-JOINT DISEASE.

Lecture by Professor LEWIS A. SAYRE at Bellevue Hospital, New York.

REPORTED BY P. BRYNBERG PORTER, M.D.

CLUB-FOOT, WITH CONGENITAL ANGULAR CURVATURE OF THE SPINE (?).

CASE 1.—The first case which I show you to-day is an infant, three weeks old, which I saw for the first time only a few moments ago, and about which I know very little. When it is undressed, however, you at once perceive that it has a very serious and unusual deformity of the legs. They cross each other, and are completely folded up, one thigh lying directly across the other. The left foot comes up across the abdomen, and the right foot over the left thigh. The muscles are found to be very rigid, but by making traction upon them very gradually and with great care, I am able to unfold the limbs, and when this is done, you see before you a very bad case of talipes varo-equinus. You notice the marked change in the color of the feet when I make this pressure upon them. The increasing whiteness shows that the circulation is interfered with to no little extent, and if this were kept up for any length of time, we should undoubtedly have sloughing result. When I release the feet, it is a remarkable fact that they are already considerably straighter than they were, and from this I would impress upon you a very valuable lesson, viz., never to let a patient with club-foot leave the room until you have restored (or as nearly as possible restored) the deformed member to its natural position by slow and continuous pressure. This is the very worst variety of varo-equinus; and yet, you see, by gradually making traction upon the feet, I can make them very much straighter. When such a contrast is produced in only three minutes, you can readily see that, after an hour's judicious manipulations, they could be made almost perfectly straight. I should advise the physician having the case in charge to do what you have just seen me do (except to keep the traction up a little longer), every day for a short time, and then to apply to each foot a piece of sole-leather which has been soaked in water so as to make it pliable. This can be readily bent to the required shape, in which it will harden, and so maintain the foot in the improved position. In a few days the foot can be made still more nearly straight, when the leather splints should be again wet and adapted; and so this process may go on until a complete cure is effected.

But, besides the club-foot, there is another very interesting feature about the case, and this is something which I never saw before—what appears to be an angular curvature of the spine at the junction of the dorsal and lumbar vertebrae. The attending physician says it is congenital, and he has been of the opinion that the contraction of the legs and feet was due to this cause. I confess that I do not fully understand the case. There is a considerable amount of motion at the point of prominence, and it is possible that this may be an instance of arrest of development, not amounting to spina bifida, but still characterized by a deficiency in one of the vertebrae. I should hesitate to manipulate the parts very freely, therefore, for fear of producing pressure upon the spinal cord; and I would advise that the child should be kept constantly in a recumbent position, and that its back should be protected from injury by a piece of sole-leather bent to the required shape.

CASE 2.—This is the little boy from North Carolina, eight years of age, who, you will remember, came to us wearing what was called a "Sayre shoe," but which, as I showed you, was doing a great deal more harm than good. About four weeks ago I operated upon him, finding it necessary to sever the unnaturally contracted muscles. I expected to have had a shoe of proper construction (that is, simply an ordinary shoe with an elastic band attached) for him to put

* By contracted I mean a muscle that has undergone structural change, and cannot be stretched or lengthened without severing its fibers, either by the knife or by force. (*Sayre on Club-foot*.)
The law which is of universal application in deciding whether in any given case we shall be compelled to resort to tenotomy is the following: Place the part contracted as nearly as possible in its normal position, by means of manual tension gradually applied, and then carefully retain it in that position; while the parts are thus placed upon the stretch, make additional point-pressure with the end of the finger or thumb upon the parts thus rendered tense, and if such additional pressure produces reflex contractions, that tendon, fascia, or muscle must be divided, and the point at which the reflex spasm is excited is the point where the operation should be performed. If, on the contrary, while the parts are brought into their normal position by means of manual tension gradually applied, the additional point-pressure does not produce reflex contractions, the deformity can be permanently overcome by means of constant elastic tension, and the more you cut the greater will be the amount of damage done. (*Sayre, Orthopaedic Surgery*.)

on to-day, but, unfortunately, it is not yet ready, and I have brought the case before you simply to show the advantage of overcoming the deformity entirely at the time you do the cutting. All that he needs now is a little more muscular power to move his foot, and that he is rapidly gaining. To assist nature, electricity and hypodermic injections of strychnia, besides friction and shampooing, may be employed, and in the meanwhile the elastic attached to the shoe will compensate for the deficient power of the muscles.

You will remember that I had to make a section of the tendo-achillis in this case. There was not a drop of blood lost at the time of the operation, nor has there a drop of pus been formed since. Although such a brief period has elapsed, he has already gained a great deal of power, so that, as you see, he is able to walk about with entire ease. The tendon that was severed now works very nicely, and the gastrocnemius is becoming more and more useful every day.

CASE 3.—Here is the little fellow from Bermuda, who came to us about three and a half weeks ago with his feet folded in, like those of the infant whom I showed you first to-day, and wearing an iron instrument, which had produced a gail upon one of them. Yet to-day, as you perceive, he can walk all around, as finely as anybody. In the treatment of club-foot I have gained a vast amount of time since I have adopted the plan of completely restoring the deformed limb at the very commencement. When section of a tendon or of fascia is necessary, it is done subcutaneously, in order to keep out the air and to avoid suppuration, and then I immediately restore the foot to its natural position, and fix it there while the patient is still anesthetized. By this means the exudation which is poured out between the severed ends of the tendon, instead of undergoing suppurative degeneration, as it would if the part was not hermetically sealed up, undergoes organization, so that perfectly healthy tissue is formed, and the whole tendon is rendered useful for sustaining the force brought to bear upon it by the powerful muscles attached to it.

The ordinary plan, which I formerly employed, and which is still followed by many, is to make a subcutaneous section, and afterward leave the foot in its deformed position. Then, when the parts are sufficiently healed, some form of apparatus is applied, such as Scarpa's shoe or Stromeyer's foot-board, by means of which (by turning a screw a little more every day) traction may be made upon the foot in such a way as not to sever the cut ends of the tendon which have become united by exudation, but to stretch the exuded material which has been thrown out between them. My impression is that, by thus elongating this newly-organized structure, you so diminish the power of the tendon as to render it almost useless, and, at all events, you cause your patient an untold amount of suffering, so that I do not wonder that many practitioners have given up the treatment of club-foot in disgust. For years, now, I have abandoned this old method, and I certainly have abundant reason to be satisfied with the results which I have obtained by the other plan of treatment. In that which I now employ the patient suffers no pain whatever, and has no trouble of any kind, whereas, when I was in the habit of using the appliances of Stromeyer and Scarpa, I met with constant difficulties, and caused my patients to suffer the greatest agony, by thus keeping up a constant strain upon inflamed tissues.

SUBCUTANEOUS SECTION OF THE TENDO-ACHILLIS AND PLANTAR FASCIA.

CASE 4.—This girl, eight years old, is the subject of marked equino-varus in both feet, the equinus being the most important feature of it. By using some little force, gradually applied, you see that I bring the left foot up into position, though the heel, never having been walked upon, is undeveloped and very small. There is no reflex spasm excited by making pressure at any point upon the tendon when in a state of tension. With the right foot, however, the case is different, for, when it is put upon the stretch, we get contractions, through reflex action, by making pressure upon both the tendo-achillis and the plantar fascia. The extensor proprius pollicis pedis is the only muscle that is of any service whatever in the way of extension. While the patient is being anesthetized, we will prepare the simple apparatus which is all that is necessary in the case. First we take a piece of cigar box which is much wider than the foot, and padding it carefully with cotton, we wrap it with a wide piece of adhesive plaster, commencing at the part of the board which is to rest against the ball of the foot, and leaving a long strip free, by which extension can be kept up. At the back part of the splint, and at right angles to its long diameter, another strip of plaster is attached, in such a manner as that its ends will cross upon the instep, and so assist to keep the dressing firm. With a small tenotome I now proceed to make the section of the tendo-achillis, which cuts almost like bone, and as adhesive plaster is applied immediately, there is no hemorrhage at all. That it is undoubtedly necessary to sever the plantar fascia also, is plainly shown by the fact that, notwithstanding the complete anesthesia, the patient gives evidence of reflex spasm when pressure is made upon it, the parts being on the stretch. This having been done, I bring the foot at once into the normal position, and in doing this I draw the two ends of the cut tendons as far apart as I intend them ever to go. It is then ready to have the apparatus applied, and I am very careful to put plenty of cotton under the ball of the foot, so as to avoid the danger of sloughing. The foot-board is held in position primarily by the strips of plaster passing from the heel up on the instep, and then by a roller bandage, which is continued up the leg. When this has been put on about half way up to the knee, the foot being brought to a right angle, the upper part of the wide strip of plaster coming from the toes, for extension, is included in its turns. In young children the roller should be carried part way up the thigh also, in order to give greater purchase to the adhesive plaster; but here it will be necessary to go only as high as the knee, reversing the plaster at that point and carrying the bandage back over it. No extra guy is needed in this case, and now, you see, the patient is all fixed and ready for transportation. If it were a case of varus, we should use another strip of plaster, making extension upon the outside of the foot, and if of valgus, one making extension upon the inside of the foot. If the adhesions take place in the manner which I anticipate, the child ought to be walking about in three weeks.

Before dismissing the subject of club foot, I wish to say a word in regard to the adhesive plaster, which constitutes so important an element in its treatment. Since the death of Mr. Hegemann, of this city, twelve years ago, I have not been able to get any plaster that was at all good, and I was in great straits until I met with that prepared by Mau, of London, which is an excellent article. Ever since I first tried it I have used it constantly, up to the present time; but quite recently I received some very good from Wyeth & Brothers, of Philadelphia, and I hope that in a short time you will be able to get all that you may require from them.

HIP-JOINT DISEASE—SECOND STAGE.

This little boy, eight years of age, has been brought to me for diagnosis, by his father, a clergyman in Pennsylvania. He has been suffering for two and a half years, and a number of opinions have been expressed in regard to the case. The physicians who have seen him seem to think that it could not be hip-joint disease, because there has never been any scrofula in his father or mother, and because he was a pretty stout-looking boy himself. Having stripped him now, and making him stand erect upon the table, with his back turned toward you, you will notice that the gluteo-femoral crease is lower and not so distinct on the left side as on the right, and that the left foot is everted. We conclude, therefore, that it is a case of hip-joint disease, and one which has reached the second stage, the eversion being undoubtedly due to effusion into the joint. The ilio-femoral ligament, you know, is finally attached to the capsule, and the latter, which ordinarily contains a very small quantity of fluid, is unfolded by the effusion, and thus the limb becomes abducted and rotated outward. You observe that the patient does not stand erect, but that the pelvis is twisted, because the weight of the body falls on the sound side, while the thigh on the affected side is flexed, on account of the effusion in the joint.

When diseased hip has gone on to the extent of producing suppuration, and reached distortion, anybody can find it out; but here is a very healthy-looking boy, and a careless observer would scarcely detect that anything was wrong with him, particularly if he were lying down upon a soft bed. But such a patient should always be laid upon the floor, or a hard table, with simply a blanket over it, and this is the method of making the examination when he is in the reclining position: In the first place, it is essential that all the spinous processes of the vertebrae should touch the table, and that the pelvis should be in such a position that a line from the center of the sternum over the umbilicus to the center of the symphysis pubis will cross at right angles a line drawn from one anterior spinous process to the other, or, in other words, that the perpendicular and horizontal axes of the pelvis should be at right angles to each other. Then, if there is no disease about the hip-joint, both limbs can be brought down until their whole posterior surface, including even the popliteal space (which renders them straighter than is natural), is in contact with the table, and yet the spinous processes of the vertebrae will still remain in the same position. If, on the other hand, there is disease of the hip-joint, the spine will become arched when the limb on the affected side is forced downward, and the angle with the table at which this is found when the vertebrae first commence to be lifted shows the degree to which the disease has advanced. Now, in the present instance, when I press the right limb down upon the table, even until the popliteal space touches it, the spine remains undisturbed, but in treating the left limb in the same manner, I find that, as soon as an angle of about forty-five degrees is reached, the back begins to leave the table, and if I continue to force it down, until the popliteal space touches, you see that it becomes bowed in the most extraordinary degree. But you will no doubt recall the case of psoriasis which I recently showed you, in which there was the same arching of the back. How, then, are we to distinguish between the two? The point is this: In psoriasis there is no eversion of the foot, and where this is present, together with the arching of the back to which I have called your attention, you may be sure that you have a case of hip-joint disease to deal with.

If I make motion of the limb, without holding the pelvis stationary, I give the patient no pain, because the whole pelvis moves with it. The joint is locked, as it were, by the rigidity of the muscles, which he has to keep up in order to prevent motion in the diseased articulation, so that he is constantly on guard for the purpose of protecting it. If, however, in spite of his efforts to resist, the pelvis is held immovable, and motion without extension is then made with the limb, it will cause him agony. On the other hand, if I take him by the knee and make extension in the line of the deformity, at the same time slightly everting the limb, I give him great relief. Dr. Aldin March, of Albany, was the first one to give us clear ideas of the pathology of this disease, and the profession is certainly greatly indebted to him therefor. In many cases an inflammatory destruction of the joint takes place without the formation of abscesses or other evidences of diminished vitality. This case being in the second stage, the least attempt at inversion inevitably moves the whole pelvis, while, if I hold the pelvis still and make gentle extension, I can make moderate movements, but am unable to produce inversion. This shows that the effusion in the joint is the first thing to be overcome in the treatment. As we have seen, as long as extension, though very slight, is kept up, the patient feels no pain, and therefore he ought to be put to bed, and have some means adopted for making gentle extension in the line of the deformity. A blister should be applied over the seat of the joint; but when the capsule is very full, it sometimes becomes necessary to puncture it, and this is one of the most difficult and delicate operations that I know of, to perform in the proper manner. It is to be done in the following way: The patient having been completely anesthetized and laid on the well side, the puncture should be made with a very short pointed trocar, just behind the trochanter major, the precaution having first been taken of directing the carbolic spray upon the part. A short pointed trocar should be used, because the canula ought not to enter the joint more than a sixteenth or an eighth of an inch, and the trocar should be withdrawn just as soon as it has penetrated the capsule. The assistant in the meantime should be constantly rotating the foot, in order to wring out the joint, as it were, and thus cause the extrusion of all its contents. It is important, moreover, that the limb should be held in this position until the wound has been hermetically sealed, when it should be immediately fixed permanently in the same position, by means of plaster of Paris or some other appropriate dressing. It will thus be seen that a great deal depends on the efficiency of the assistant; but if the above plan is properly carried out in all its details, you will be almost certain to avoid constitutional disturbances, which might otherwise occur in a very marked form.

On examining this boy more carefully, I find that there is another difficulty present, which is, in all probability, the indirect cause of the hip-joint disease, and that is, an adherent prepuce, with contraction. As a consequence of this, he suffers from constant priapism and reflex spasm, and his father informs me that when he was a little younger he was all the time tumbling about in the most unaccountable manner, so that it was, no doubt, in one of these falls that he received the injury which eventually resulted in the diseased hip. As soon as the effusion is sufficiently reduced, the long or short splint will be applied, according to circumstances, though it is likely that the short one will answer every purpose here.

CORROSIVE SUBLIMATE IN DYSENTERY.

By CHARLES H. HALL, M. D., Macon, Ga.

A MARRIED woman, of twenty-eight, applied to me through her husband. For two months she had been daily having from ten to twenty straining, painful operations, feces sometimes natural, yet afterward mucus and blood, and again feces soft, mucus and blood intermixed. He represented that she had no fever; may possibly have had some in the beginning; she was weak; had no appetite, and suffered continual pain. Had been treated by a physician with castor oil, frequently repeated, as a purgative, opium, etc. I gave him one-half grain of corrosive sublimate, dissolved in eight ounces of water, directing that she should take four teaspoonfuls from this each day. He reported in one week that his wife was very much better, but still had four or five actions each day, and very much of the same character. I continued the mercurial, same dose, and directed five grains of sulphate of copper in a pint of water to be used twice daily by enema. Reported in a week that his wife was well.

A negro man, of fifty, came to me 1st of January, 1877. For six months he had been troubled each day with teasing desire to stool, and would pass mucus and blood at each effort; no fever; considerable emaciation. Tongue was so coated with tobacco that I could gain no information from its appearance. There were no piles, neither had been. He had taken castor oil, opium, and other medicines, as prescribed. My diagnosis was catarrh of rectum. I gave him one grain of corrosive sublimate in a pint of water, directing him to take a teaspoonful every two hours. He reported in a week, saying he was much better than he had been for months. Continued treatment. Met him accidentally one month afterward. He said he was entirely well, and working every day.

November, 1876. A lady, of 26 years. For eighteen months she had suffered with frequent discharges from her bowels. For days she would have small, frequent, and intensely painful discharges of mucus and blood. Suddenly these would cease, and she would have large, very thin and offensive actions, and these very frequent. She was greatly emaciated, her tongue reddish, very smooth, something like the surface of a glass. Her appetite was variable, sometimes morbid, and then again having a loathing of all food. Her abdomen was tender and flat. She was up, and attempting to keep house, but very feeble. She had been under various treatments, lay and professional; was convinced that no good would result from any treatment; especially averse to "bad-tasting medicine." Diagnosing a chronic catarrhal condition of whole alimentary mucous membrane, I prescribed one grain of corrosive sublimate to a pint of water, teaspoonful every two hours; five grains of salicin three times a day; to have, per anum, an injection of sulphate of copper (five grains to a pint of water). Salicin was discontinued after one week, and the corrosive sublimate continued for three weeks longer.

In January, two months after my first visit, she had gained flesh wonderfully. Her actions were free from blood and mucus, and had been for four weeks. In twenty-four hours she would have from two to five rather loose actions. Abdomen was no longer tender. She was very much stronger, and very hopeful of final cure. Bismuth and a tonic were prescribed. 1st of March she reported herself well.

A girl of eleven years. For months she had had an affection of the bowels; was very pale; had lost much flesh; appetite variable and capricious. She would have a natural-looking action, but accompanied with great pain, and around the feces mucus and blood. This probably once or twice in twenty-four hours, but all through the day and night as much as fifteen or twenty times, she would have small discharges of nothing but mucus and blood, with great straining and pain. She had been treated by many doctors. I examined her rectum, but could discover no fissure, ulcer, or piles. Diagnosing a chronic catarrh of rectum, prescribed small doses of mercury and chalk, and as her digestion was imperfect, pepsin, ten grains with each meal. She soon evidenced improvement, and in three months was dismissed perfectly well.

A lady, about twenty-five, had been three weeks sick with rheumatism; was taken with an intercurrent dysentery; stools very frequent, slimy, and bloody; great tenderness. I found her taking laudanum very freely. She was the patient of another physician; he being called out of town, I was called in. I stopped the laudanum and the rheumatic remedies; gave her one hundredth of a grain of corrosive sublimate every two hours. In twelve hours she was greatly relieved, and in forty-eight hours had no further trouble.

A quadroon woman, of twenty or twenty-five years, had been sick three days, discharging from her bowels blood and mucus, with a great deal of tenesmus; considerable tenderness over the whole abdomen; high fever. Prescribed castor oil, quinine, as an antipyretic, 20 grains in two doses; turpentine stupes over the abdomen; laudanum to be given as soon as oil acted. Next day my patient was no better in any particular; oil had acted; laudanum, etc., had been given. Continued quinine (18 grains in two doses); ordered one-half grain of corrosive sublimate in half a pint of water; teaspoonful every two hours. Next day fever was not quite so high; dysentery possibly slightly better; discharges not so frequent, and tenesmus not so distressing. Continued quinine and corrosive sublimate. Fourth day, temperature normal; tenderness over abdomen greatly improved; reported only two actions since last visit, much more fecal in character. Stopped quinine, continued mercury. Patient had no further trouble.

These cases are taken from my case-book, to illustrate the efficacy of "small and frequently repeated doses" of mercury in this disease. There cannot be any doubt of the success, in the great majority of cases, of this method of treatment. I could furnish records of many more successful cases, and a few unsuccessful ones, treated in this manner. My success so far has been very gratifying, greatly preponderating. Ringer, who advises it in his book, deserves no credit for it except for popularizing it. Any one curious on the subject of his small doses, not only in this disease, but in almost every other one of his recommendations, has only to refer to homeopathic works and find that he has plagiarized. Take up any one of their works, even the domestic manuals of twenty-five years ago, and you will find corrosive sublimate put at the head of the list of remedies in dysentery. Although a regular physician of the strictest sect, I believe we should give credit even to irregulars where they deserve it.—*Medical and Surgical Reporter.*

MANIA METAPHYSICA (Grübel-sucht) is recognized as a new form of mental disease. It shows itself chiefly in young people in constant and useless inquiries into the why and wherefore of things, and is to be treated by small doses of potassium bromide.

MENTAL ILLUSIONS.

"In many ways," says Plautus, "do the gods make fools of men, by dreams and waking visions, by memories and presentiments." Though the gods have gone, the fools have not, and a goodly number of them still pin their faith to the follies referred to by the great Latin comedian.

Were anything wanting to show how little the spirit of science has penetrated the general mind, it would be supplied by the eagerness to adopt the delusions of spiritualism, the trickery of mind-reading, the exaggerations of mesmerism, and the like, as proofs of the supernatural; or, to put it more clearly, the belief in the supernatural itself, as something independent of or contradictory to the natural.

Step by step, the study of mental pathology has stripped the wonder world of former ages of its most marvelous apparatus. The divine fury of the prophetess, the devils which possessed the epileptic, the demoniacal power of the witches, the potent words of the magician, have all been shelved by simple explanations which leave no food for the lover of the miraculous.

There still remain several classes of phenomena for which, up to the present, no entirely satisfactory explanation has been offered.

One of these is the curious impression that comes over many persons, at times, that some scene, some experience or some occurrence, which happens to them for the first time, has already transpired or been familiar to them, in the long past. As Tennyson has it—

"Something felt, like something here;
Something seen, I know not where;
But when, no mortal may declare."

Some explain this as a reminiscence of forgotten dreams; others, that an association of similarity is evoked, but which is so incomplete that on attempting to seize it the mind loses the chain of thought; or, again, that it depends on the reflex action of the other lobe of the brain, excited by some cause unknown, and which thus produces an almost simultaneous double impression.

The following case, where this delusion passed into positive insanity, renders the last mentioned suggestion probable. It is reported by Dr. A. Pick, in the *Archiv für Psychiatrie*, B. vi.:

"The patient was a furrier, and had traveled, practicing his trade, to Copenhagen and St. Petersburg. He was very excitable, suffered from headaches, and fancied that people put poison in his food and listened to his conversation. He thought that he heard voices weeping above his room. On account of such delusions he was sent to the asylum. He is described as rather a weakly man for his age, which is above thirty. He possesses a good memory, and is skillful at mathematics. From his early years he had a vague consciousness, as if the events he was passing through had been already experienced. At first these notions were of a dim and uncertain character, but in the course of time they got clearer, so that he thought he possessed a double nature. It seemed that the combinations of social life, the changes of the weather, the events of the political world, repeated themselves to him for the second time. He thought it strange that no one ever mentioned these repetitions of events. He spoke about them to his friends, but only got evasive replies.

"The first time that these illusions were clearly portrayed in his mind was in the autumn of 1868, in St. Petersburg. Visits to pleasure resorts, the sight of public amusements, and casual interviews with persons, so affected his memory that he was convinced that he had already visited the same places, and seen the same men, under exactly the same circumstances. Sometimes this conviction occurred in the same day; but it often became clearer days after, when he had leisure to think over the events. Sometimes the renewed recollection came during the night; this Dr. Pick considers to be a form of dreaming."

In fact, there is a certain analogy between this illusion of memory and another, which constantly occurs in dreaming. We refer to the undoubted fact that a dream may be what is popularly considered *retrospective*. A dream occurring at the moment of being aroused (and generally supposed to be suggested by the same external impression which recalls the sleeper to consciousness) will seem to lead up to the impression, instead of taking its start from the latter. For example, a man is suddenly awakened from a deep sleep by the report of a pistol; he may dream a scene *antecedent* to the sound that aroused him, and the report will seem to have occurred as a link in the chain of incidents, a considerable portion of which had been completed *before* the explosion.

It is impossible to question the fact of this familiar phenomenon. The explanation is, however, by no means easy, and we are, in truth, driven to accept one of two startling theories—either dreams must be "retrospective," or they must be "instantaneous." The last mentioned is the less embarrassing hypothesis, and its adoption would remove some difficulties in the general question of dreams which upon any other presumption must prove exceedingly formidable. If dreams are pictures, they may flit through the mind in a moment of time; and there is nothing very perplexing in the fact that a train of events leading up to an impression which is itself the cause of the dream is presented.

A similar illusion of the time sense is very marked in intoxication by hashish. It may be said of those under the influence of this drug, that to their perception, as to the Homeric gods, "they take a step and ages roll away." To cross a room seems to require centuries.

In fact, we must remember that our most familiar experience teaches us that the mental estimate of time varies infinitely, and that in the opinion of the highest philosophy there is absolutely no common measure between it and mental action. There is, indeed, time required for the transmission of thought along the nerve filaments, but none to measure the thought itself. Long ago this was clearly pointed out by Kant, and the more closely we study psychology experimentally, the more convinced must we become of the correctness of his view.

THE COLOR OF THE RETINA.

PROBABLY the most interesting discovery of the past year in physiology is that made by Boll, that the retina possesses in health a peculiar red color, which is constantly being destroyed by the influence of light, and is as constantly being regenerated by the ordinary processes of nutrition. The "vision red," or "erythropsin," as its discoverer names it, attains its maximum after a night's rest and sleep, or when an animal has been kept for some hours in darkness; it is soluble in solutions of the biliary acids and in glycerine, and probably plays a part in the production of the red reflection from the fundus of the eye seen on ophthalmoscopic examination, as well as in the ordinary acts of vision.

THE DYSPEPSIA OF SMOKERS.

M. RÉVILLOUT reports, in the *Gazette des Hôpitaux*, two cases of gastralgia attributed to the use of tobacco. The first case occurred in a man, aged fifty-two, in M. Vulpian's wards. He had always been moderate in everything except the use of tobacco; had never undergone any privation; had always been able to choose his food, and had been careful in his diet. On six different occasions he had been seized with extremely acute attacks of pain in the stomach, not extending to the back, and coming on more or less quickly after every meal, bringing on, also, vomiting of the food. In the intervals of these attacks, of which the average duration was about six weeks, his health seemed tolerably good, with the exception of some vertigo, dizziness of the sight, and weakness of the legs. These troubles were more marked when the patient felt better and smoked than when, suffering with gastric troubles, he had no appetite for anything, and temporarily left off tobacco.

M. Révillout also reports a case in which a gentleman in good circumstances, following an excellent hygienic system, found his digestive functions gradually failing, while his strength diminished. Later on he was attacked with vertigo, staggering while walking, and spasms, and prickings in the limbs. After every meal severe pain was felt in the epigastric region; the face was pale, the speech gasping, the heart-beats uncertain, and the body generally discolored. This patient smoked from twelve to fifteen cigars daily. Under advice, he reduced this number to two, and immediately a considerable improvement took place. He again took to excessive smoking; but, as the original symptoms returned, he was again obliged to abstain from tobacco. Under medical advice, he washed the tobacco of which he made his cigarettes in a coffee-percolator, by first throwing on it ammoniacal water, then repeated baths of hot water. The nicotine was thus partly dissolved out, or mechanically removed by the warm water. The tobacco, when washed, was spread out in the sun to dry, on paper, and thus modified satisfied the patient, who from that time was not troubled with dyspepsia or vertigo.

INSANITY IN THE UNITED STATES.

By T. J. HUTTON, M. D., of Canandaigua, N. Y.

INSANITY is on the increase in the United States, and has been for many years. It is but reasonable to suppose that the perverted business and industrial relations of the past four years have given it an additional impetus, although little appears in asylum records under this head. There are now some fifty thousand persons in the insane asylums of the United States (that is equal to twice the number of our regular army), and many others treated outside asylums. No man can declare himself absolutely safe from an attack of insanity, whether his family history be clear of it or not. It is no respecter of persons; it attacks high and low, learned and unlearned.

The most accurate statistics gleaned teach "that one person in every sixteen hundred and ninety of the population will become of unsound mind in the course of each and every year." If this ratio be correct, a population of 44,000,000 will annually add 26,035 persons to the list of the insane, not speaking of the numbers that will have accumulated in prior years. This annual yield, at a cost of keeping of \$266.81 per capita (the average cost in 36 of our most cheaply conducted asylums), will cost the State—for the State stands in loco parentis to the afflicted—\$6,956,398; this sum added to the cost of sheltering, \$52,070,000, estimated at \$2,000 per capita (\$3,000 is the usual estimate), will impose on the State an annual burden of \$59,026,000, or an average yearly tax (were it so levied) of \$1.34 for every man, woman and child in the United States.

In view of the many-sided importance of this subject, it deserves and demands the studious attention of all men. As physicians, it becomes us to know all that is known of this "sorest of all maladies;" as philanthropists to prevent, and when we cannot prevent, alleviate; as intelligent citizens and tax-payers that we may know how to expend to the best advantage the millions that are annually expended for the maintenance of this numerous corps of the invalid army of the republic. What, then, constitutes insanity, and what are the chief causes that produce it? Waiving technicalities, that man or woman is insane, in the eye of the law, whose mental operations are so impaired by disease that the individual is no longer able to take care of himself (or herself) and of his (or her) estate. It simply means of unsound mind, of diseased brain. It has nothing to do with the supernatural—with spirits, demons, or even with Wilkie Collins' monsters; and the sooner this idea, which still hovers round as a relic of ages of ignorance and barbarism, is abolished, the better it will be for the afflicted ones. There is no sense in the peculiar odium which is associated with the insane state in the minds of many; it is a compound of ignorance, pride and ungodliness.

The principal forms of insanity are the hereditary and non-hereditary. To have hereditary insanity means that one's parents or more remote ancestors were insane, or suffered from other nervous disease, which morbid taint appearing in the offspring in the form of pure insanity—for all nervous diseases are interchangeable, that is to say, any nervous affection may in a subsequent generation appear as that same nervous affection, as some other nervous disease, or as insanity, unsound mind. Non-hereditary insanity is that which appears in an individual whose family history is free from insanity and other well-marked nervous diseases.

The greatest factor in the production of both forms of insanity, hereditary and non-hereditary, is overindulgence in alcoholic liquors. It has recently been claimed that liquor, directly or indirectly, in one generation or another, is the cause of all insanity, but this is absurd. Disease attacks the brain as well as other bodily organs, from common causes incident to human life and to the delicate mechanism of our cerebral machinery. It is a safe and moderate estimate to say that it causes one-half of all the madness that exists; it, therefore, muddles more than 13,000 brains, and damns more than 13,000 souls per annum, in this country alone. Is it not the duty of the State to protect its citizens? It should prohibit, by stringent laws, severely executed, the sale of those poisons sold as alcoholic beverages, and it should and ought to regulate and limit the sale, even of pure liquors, both of which blast and pauperize so many people, and so largely increase the taxation.

Having thus mentioned what is generally admitted to be the greatest factor in the causation of insanity, it is not an easy matter to enumerate all the causes that produce it, in the order of frequency, for the reason that some cases are due to more than one cause. Paresis, which contributes some fifteen per cent. of the inmates of our private asylums (twenty per cent. to the English private asylums), is a disease of wine and women. Perhaps, however, it is safe to

say, indeed my little experience warrants me in saying, that sexual excess is by far the more efficient element of this compound cause in the production of paresis. Sexual excess has been proven in every case of paresis I have ever seen, and at the present writing I have quite a number in my care. Paresis may result, in rare instances, from overtaxation of the mind in the direction of legitimate business. Sexual excess, with and without strong drink, produces unsoundness of mind in other forms than paresis, and thus swells the proportion of insanity caused by it much higher than that given for paresis. All estimates are but approximations. Self-abuse produces some ten per cent. of the number in private asylums; the opium habit about five per cent.; irregularities in females a few per cent. The "wastes and burdens of life," losses, sorrows, griefs, disappointments, overtaxation of the mind in the pursuit of good and laudable objects, especially overdraughts on the imagination, all lead to mental aberration.—*Medical and Surgical Reporter.*

TREATMENT OF PARALYSIS OF THE MUSCLES OF THE EYE.

PROFESSOR J. MICHEL, in the *Monatsschrift für Augenheilkunde*, November, 1877, recommends the treatment of paralysis of the muscles of the eyeball by gentle traction. His treatment, which was successful in a recent but total paralysis of the abductors, of rheumatic origin, consists in taking hold of the insertion of the affected muscle with a pair of fixing forceps, and gently drawing the eyeball as far as possible in the direction in which the muscle would move it; afterward bringing it back to its former position. This maneuver is repeated backward and forward for about two minutes every day. The author states that the manipulation is attended by but little pain, and that the slight inflammation set up in the conjunctiva is easily combated by cold applications. After each sitting a slight amelioration was observed. Immediately after the sitting, the muscle was found to be capable of contracting to the extent of a line and a half to two lines. This power was less after an hour, but was still perceptible. He states that recovery was perfect after five weeks of this treatment.

ANTISEPTIC DRESSINGS.

THE *British Medical Journal* states that in Germany Professor Thiersch has come to the conclusion that a saturated solution of salicylic acid—that is to say, 1 to 300—prevents putrefaction of the blood and secretions of a wound, while it produces no irritating effect upon recent or granulating wounds, and gives no cause for alarm by the passage of salicylic acid into the circulation. He uses a solution of salicylic acid for washing instruments and the hands of the operator and his assistants. The spray is of salicylic acid which proves, however, very irritating to the mucous membranes of the persons engaged in the operation. The dressings are simple enough. Salicylic acid being non-irritant, no protective is required, according to Thiersch; but, at least in healing surfaces, the protective has the additional advantage of protecting the granulations and the delicate new epithelium covering them from the danger of sticking to and being injured by the dressings or their removal. But Thiersch uses no protective. He places immediately upon the wound a layer of wadding containing three per cent. of salicylic acid then another layer containing ten per cent. Blaser, pharmacist to the hospital at Leipzig, employs the following formulae for the preparation of these dressings. For the three per cent. wadding: Dissolve 750 grammes of salicylic acid in 7,500 grammes of alcohol of specific gravity 830. Add 150 liters of water at 70° to 80° Cent. (158° to 176° Fahr.). Place in the mixture 25 kilogrammes of cleaned wadding. For the ten per cent. wadding: Dissolve 1 kilogramme of salicylic acid in 10,000 grammes of alcohol of specific gravity 830. Add 60 liters of water at 70° to 80° Cent. Place in the mixture 10 kilogrammes of cleaned wadding. To saturate the wadding, he uses a shallow vat, in which it is laid, layer by layer, taking care not to put in more than two or three kilogrammes at one time, and that one layer is well saturated before the next is put on. When all are in, they are to be turned over, so that the bottom one comes to be at top, and left for ten minutes, then removed; and, as they cool, the salicylic acid crystallizes out. Finally, the wadding must be dried in a warm place. Thiersch has also tried a dressing composed of jute saturated with salicylic acid; but the powder was disengaged in large quantities, and was extremely disagreeable to the surgeon.

NEAR-SIGHTEDNESS.

By PROF. B. G. NORTHPROP.

BEING near-sighted myself, I took a deep interest in the investigations recently carried on in Germany as to the causes and prevention of this trouble. Eminent oculists in that country have carefully examined the eyes of thousands of children, and the general conclusion which they regard as fully established is that there is a gradual increase of myopia in the ascending grades from the primary school to the gymnasium. The latest investigations prove that near-sightedness is not only a disease, but one that predisposes to more serious ocular troubles, a disease usually originated during school life, or at least under twenty-one years of age, and yet preventable by the early use of proper precautions. The interests of thousands of children whose eyes are needlessly suffering invite the discussion of this subject.

Sight is the noblest avenue of the mind, and its impairment or loss is a greater evil than would be that of any other bodily sense. Because the near-sighted when old can read without glasses, their eyes have been supposed to be peculiarly strong. But oculists are now agreed that myopia is a disease which predisposes its subjects to more serious trouble. The great number of myopes who become partially or totally blind shows the necessity of investigating the causes and preventives of near-sightedness. This disease is more prevalent in Germany than in any other country of the world, and the subject has lately commanded the attention of her Reichstag as well as of her most distinguished physicians. In her schools sixty-two per centum are myopic, while in America, so far as the examinations extend, the rate is about twenty-seven per centum.

In Germany many of the schoolhouses are very old structures originally built for convents and poorly lighted. The German text itself is obscure compared with the clear Roman letters. With all their conservatism and reverence for ancient forms and usage, many German scholars advocate the adoption of the plainer Roman letters. Especially in the smaller type, the German text has needlessly taxed the eyes of her people. Professor Donders, the highest authority on this subject in Europe, says: "Near-sightedness is most common in cultivated nations, and among the States of Europe visited by me nowhere did I meet so many

myopes as in Germany." The absence of near-sightedness among savages is an argument for the theory that one cause is undue tension of the eyes for near objects. Germany is confessedly one of the most studious nations of the world. Its scholars are especially sedentary in their habits, study more hours a day, and have less fondness for games, sports, outdoor scenes, and exercise than American students, and are less watchful in regard to ventilation. Reute dwells on the deleterious effects of insufficient and faulty illumination. Admirable as is the "German student's lamp," its use is limited. I often found scholars in German families studying by the flickering light of candles, and was frequently unable to get good light for my night work.

Among the causes of visual weakness among American youth may be named a stooping posture, which cramps the chest and brings the eye too near the book or paper; reading at twilight and late at night and studying by lamp-light in the morning; reading in the cars; using kerosene lamps without shades; reading while facing a window, or any light, natural or artificial, and still more while facing the bright sunshine; reading dime novels or other books printed in too fine type (all books printed in diamond, pearl, agate, or nonpareil are unfit for children's eyes); wearing a veil; and neglecting to cultivate far-sightedness by examining carefully distant objects. Hence myopia is more common in cities than in the country, among those working on near minute objects than those laboring in the fields with a wider range of vision and more objects to invite habits of observation. The increase of myopia has been attributed to modern devotion to literary pursuits, as savages are generally exempt from this trouble. But if proper precautions are taken there is no necessity that myopia should increase in a nation in proportion to its devotion to intellectual pursuits. Though it is often hereditary, this predisposition may commonly be counteracted by proper care.

Says Dr. E. G. Loring: "The great period for the development of myopia—that is, for its beginning—is from the tenth to the fifteenth year, just at the time when the body, as a whole, is developing most rapidly. Near-sightedness is essentially a disease of childhood, or, at the latest, of adolescent life. Donders declares that he never has seen a case of myopia originate after the twentieth year. Myopia is especially prevalent among the so-called cultivated classes. Yet students do not use their eyes for more hours a day, and on finer objects, than jewelers, engravers, draughtsmen, seamstresses, type-setters, and many others who engage in long-continued work on small objects. These occupations do not show any tendency to near-sightedness, while the professional and literary callings do. The principal reason why the members of mechanical arts show less myopia than those of studious and literary occupations is not because they use their eyes less, but that the application of the eyes occurs at a different time of life and under entirely different conditions.

The statistics already gathered in this country as well as in Europe clearly show that there is an increasing tendency to myopia in the ascending grades of schools. To illustrate the extent and thoroughness of these investigations both in Europe and America, Dr. Erismann's statistics were made in St. Petersburg on the eyes of 4,358 scholars. Dr. Conrad's at Königsberg on 3,036. Dr. Cohn at Breslau examined 10,060 pupils. Dr. Plüger examined 1,846 pupils at Lucerne.

Drs. Agnew and Loring in New York, and other oculists in Boston, Brooklyn, Buffalo, Cincinnati, and other cities in our country, have examined the eyes of many thousands of scholars, and all agree that myopia increases from the primary room up to the highest grade of school. As my knowledge of this subject is experimental rather than either scientific or professional, I am mainly indebted to the eminent oculists whom I have consulted for the list of causes and preventives above named.—*N. Y. Evening Post.*

ANALYSES OF CANE AND BEET-ROOT SUGAR ASH.

By J. W. MACDONALD.

THE samples were obtained by preserving the ashes of all cane and beet sugars analyzed in the laboratory of a large sugar refinery during one year. The analyses may therefore be taken as representing the average composition as regards bases, phosphoric and carbonic anhydrides and chlorine having been displaced by the sulphuric acid employed in the sugar analyses.

It will be noticed that cane ash contains a larger proportion of lime, magnesia, ferric oxide and sand than beet. These substances are removed from the juices in the beet manufacturing, but in the West Indies and cane-producing countries the manufacture of sugar has not yet reached such a perfect state.

	Cane Ash.	Beet Ash.
Potash.....	28.79	34.19
Soda.....	0.87	11.12
Lime.....	8.83	3.60
Magnesia.....	2.73	0.16
Ferric oxide and alumina...	6.90	0.28
Sulphuric anhydride.....	43.65	48.85
Sand and silica.....	8.29	1.78
	100.06	99.98

Chemical News.

NEW PRODUCT OF THE OXIDATION OF LEAD.

By H. DEBRAY.

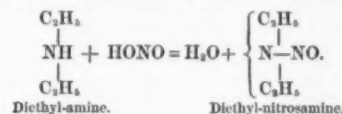
THERE exists a sesquioxide of lead, or rather a compound of plumbic acid and protoxide of lead in equal equivalents, quite distinct from the sesquioxide, commonly so-called, which is merely a mixture. The sesquioxide of lead is not decomposed by the influence of heat, as is the general case with direct compounds, like the carbonate of lime. Such bodies, if heated in a limited space at a temperature where their decomposition begins, cease to be decomposed when the temperature of the gas evolved in the apparatus has acquired a certain value depending solely on this temperature. But the sesquioxide of lead is split up into oxygen and minium, which, at least in the circumstances indicated above, is not capable of reoxidation. The sesquioxide, therefore, under the influence of heat behaves like lead carbonate, or any other indirect compound.

ACTION OF BORON FLUORIDE UPON ORGANIC SUBSTANCES.—FR. LANDOLPH.—On treating ordinary camphor with boron fluoride the author obtained as results of the reaction camene and certain of its polymers and two carbides of the series C_2H_{2n-6} . The gases given off are boron fluoride, carbonic oxide, ethylene, and propylene. Acetylen and carbonic acid are absent.

CHEMICAL SOCIETY, LONDON.

March 22, 1878.

"On Aromatic Nitrosamines," by Dr. OTTO N. WITT.—In 1874 the author made some experiments on the action of nitrous acid, and especially its ethers, on secondary and tertiary amines. The facts observed were communicated to the Chemical Societies of Zurich and Berlin. In his inaugural dissertation (1875) the author gave a detailed account of the formation and properties of diphenyl-nitrosamine. Since that time a more careful study of some complicated reactions of diphenyl-nitrosamine has been made, and the results of these investigations the author gives in the following paper: Whenever a secondary amine is acted upon by nitrous acid, water is given off, and a nitrosamine (N), a substituted ammonia which contains, instead of at least one hydrogen, the mono-valent group NO in immediate connection with the amiacal nitrogen) is formed. Thus:



Similarly, by the action of ethylic nitrite, amyl nitrite, or nitrous vapors on diphenylamine, diphenyl-nitrosamine is formed. This latter substance crystallizes readily in large, honey-colored, monoclinic crystals, melting at 66.5° C., soluble in alcohol, benzol, etc. It dissolves readily in concentrated sulphuric acid with a beautiful blue color, large quantities of nitric oxide being evolved. Powerful reducing agents split off ammonia, and reproduce diphenylamine.

The action of aniline and the primary monamines on diphenyl-nitrosamine is violent, diphenylamine being regenerated, with the formation of diazo-benzol, the latter forming successively diazo-amido-benzol and amido-azobenzol. Under certain circumstances a secondary reaction takes place, a substance, $C_{12}H_{11}N_3$, being formed, which, when treated with sulphuric acid, gives a blue coloring matter with a crimson fluorescence and a spectrum of three dark bands. If ordinary ethylic nitrite—obtained by passing nitrous vapors into alcohol—be used, a mixture of products is formed, in the investigation of which the author encountered many difficulties. When burnt in a combustion-tube these bodies gave off rapidly large quantities of nitrous vapors, while a very dense charcoal was left behind, which was difficult to burn completely. On investigation the author found that the substance commonly called anhydric nitrous acid (prepared by the action of nitric acid on starch, etc.) is really N_2O_4 , and splits up by contact with alcohol or water into nitric and nitrous acids. Thus ordinary ethylic nitrite always contains nitric acid. The author, therefore, used mixtures of pure amyl nitrite and nitric acid. Acting with these on known weights of diphenylamine, and moderating or accelerating the reactions by the use of various solvents, he has obtained mono-nitro-diphenyl-nitrosamine and two bodies which, on the removal of their nitroso-groups, yielded dinitro-diphenylamine and an isomer. Mono-nitro-diphenyl-nitrosamine.—To 20 grms. of diphenylamine, finely powdered, a mixture of 15 c.c. nitric acid, 35 grms. pure amyl nitrite, and 100 c.c. of methylated alcohol is added. On shaking—and, if necessary, heating—crystals separate. The liquid is now cooled by ice, when a crystalline deposit is obtained, which is filtered off, washed with spirit, dried, and recrystallized from chloroform. This substance forms light yellow plates, melting at 133.5° C., soluble in benzol, hot alcohol, and glacial acetic acid. When treated with strong sulphuric acid it gives off nitric oxide, the liquid becoming purple. By the action of aniline or alcoholic potash mono-nitro-diphenylamine was obtained in pale yellow glistening scales, melting at 132° C. It does not color sulphuric acid, but dissolves in alcoholic potash with a fine red color. By the action of bromine on mono-nitro-diphenyl-nitrosamine dissolved in glacial acetic acid two products were obtained, one in canary-yellow colored silky needles, fusing at 208.5° to 209°, the second in heavy, well-shaped, small prisms, melting at 214.5° to 215°. If, instead of the quantities given above, the following be used—17 grms. diphenylamine, 50 c.c. glacial acetic acid, 40 c.c. nitric acid, 50 c.c. methylated spirit, and 48 grms. nitrite of amyl—a light yellow sandy powder is obtained, which dissolves in sulphuric acid with a dirty violet color, nitric oxide being given off. The analyses seemed to indicate a formula intermediate between di- and trinitro-diphenyl-nitrosamine. The author, therefore, acted on the substance with aniline and alcoholic potash, precipitating the resulting liquid with dilute hydrochloric acid. By treating this precipitate with alcohol a solution was obtained which furnished long, thick pointed, dark yellow needles, fusing at 214°, and dissolving in alcoholic potash with a bright purple color. Analysis proved this substance to be dinitro-diphenylamine. The residue insoluble in alcohol was recrystallized from xylene, and obtained in granular vermilion crystals, fusing at 211.5°, which dissolve in alcoholic potash with a scarlet color. Analysis proved this substance to be isomeric with the last. All the above substances, when treated with strong nitric acid, yield hexa-nitro-diphenylamine. The author points out that the method of nitration above described will probably be found applicable in many cases where nitration has hitherto offered unusual difficulties, and also lends some support to the theory that the formation of nitroso-compounds always precedes the introduction of the nitro group into the molecule of aromatic substances. The author mentions, in conclusion, that Mr. Meldola communicated to the *Chemical News* (Feb. 8, 1878) a note on a new coloring matter. On examination this new dyestuff, "Citronin," turned out to be a mixture of mono- and dinitro-diphenylamines. Mr. Meldola, on learning that the author had been engaged with these bodies for some years, relinquished the investigation. For this act of courtesy the author thanks Mr. Meldola, but wishes to state that the merit of the practical application of this substance as a dyestuff belongs solely and entirely to that chemist. The author promised a second paper in continuation of the research, and stated that, but for the incident just referred to, he should not have published his researches at so early a date.

Mr. Meldola said that Dr. Witt had given a perfectly correct statement of the case as far as he was concerned. At the time he first obtained citronin he was aware that Dr. Witt had been working at the subject, and therefore thought that he was the proper person to communicate with. His communication, he ventured to think, considering the interesting paper they had just heard, had been attended with the happiest results as regards the Society and himself.

Mr. Groves remarked that when phenol is acted upon by dilute nitric acid, a small quantity of nitroso-compounds seems to be first formed; also, in the formation of trinitro-

orcin, nitroso-compounds seemed to be at first produced, thus confirming the statement of Dr. Witt.

Dr. Armstrong thought that, although in many cases we had evidence of the pre-formation of nitroso-compounds, yet it probably was not always the case. Thus some of the sulpho-acids of phenol nitrate with very great readiness without any indication of nitroso-compounds being formed.

After a short discussion between Drs. Armstrong and Witt as to the constitution of the bodies mentioned in the above paper—

The President gave the best thanks of the Society to Dr. Witt for his interesting paper, which was illustrated by experiments and the exhibition of specimens of the above beautifully crystallized substances.

"On a New Process for the Volumetric Estimation of Cyanides," by J. B. HANNAY.—The cyanide is dissolved in water, and the solution is rendered alkaline by ammonia. A half-strength decinormal solution of mercuric chloride is run in with constant stirring. At first the reaction $2\text{KCN} + \text{HgCl}_2 = \text{Hg}(\text{CN})_2 + 2\text{KCl}$ takes place, but as soon as all the cyanide has been thus decomposed, the slightest trace of mercuric chloride renders the liquid distinctly opalescent. The end reaction is sharply marked and very delicate. Many experiments were performed as to the action of alkaline sulphates, chlorides, and nitrates. The results were similar to those already obtained by Tuson and Neison (*Chem. Soc. Journ.*, 1877, ii., 670). Very large quantities of ammonium salts prevent the appearance of the opalescence. Cyanates and sulpho-cyanides do not interfere. The presence of silver salts does not hinder the reaction. The author, therefore, recommends the process as one of great facility.

"On Certain Bismuth Compounds," by Mr. M. P. MUIR.—In the first portion of this paper the author details reactions illustrating some points of contrast between bismuthous and phosphorous chlorides. The latter substance is oxidized with comparative ease, and therefore acts as a reducing agent in certain reactions; the former undergoes only incomplete oxidation, and therefore exerts no action in such cases. The two oxalates of bismuth, $\text{Bi}_2\text{C}_2\text{O}_4 \cdot 6\text{H}_2\text{O}$, and $\text{Bi}_4\text{C}_2\text{O}_8$, are then studied. Experiments on the production of some so-called bismuthates are next detailed. The author inclines to the hypothesis that the higher oxides of bismuth exhibit exceedingly feeble acid characters. The paper concludes with the description of some experiments on bismuthous iodide. The oxidation of this compound by air when in a fused state is compared with the behavior of the corresponding chloride and bromide under similar conditions. The iodide oxidizes much more slowly than either the chloride or bromide. Bismuthous iodide prepared in the wet way is more readily decomposed by water than the same salt prepared in the dry way.

The thanks of the Society were given to the author, who exhibited an interesting series of bismuth compounds.

Salicylic Acid.—Mr. Williams then exhibited a splendid sample of salicylic acid, about 24 ounces, prepared from the oil of wintergreen, the natural product crystallizing apparently better than the artificially prepared acid; also, about 1 gallon of pure methylic alcohol.

Methylic Chloride.—Dr. Witt, in answer to Mr. Maxwell Lyte, said that the "vinasses," formerly a waste-product of the beet-root sugar manufacture, had lately been utilized under a patent for the production of methylic chloride, which was largely used by the aniline color manufacturers. The gas was prepared, washed, and pumped into metal reservoirs containing 25 kilograms, each, the patentee, Brignonet, making as much as 1,000 kilos. a day.

ON A NEW FORM OF MEASURING APPARATUS FOR A LABORATORY SPECTROSCOPE.

By J. EMERSON REYNOLDS, M. D., Professor of Chemistry, University of Dublin.

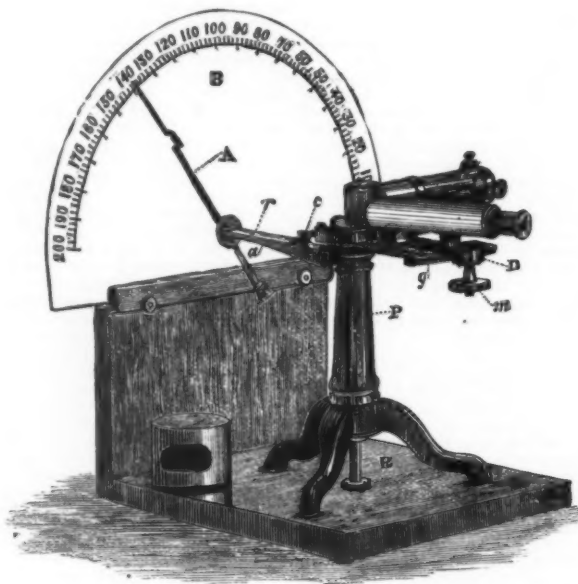
THE measuring apparatus for a laboratory spectroscope which I have been asked to describe was fitted about a year ago to an instrument in common use in the College Laboratory, and has afforded very satisfactory results. My chief aim in planning the arrangement was to facilitate the measurement and identification of spectral lines and the mapping of spectra under circumstances admitting of little general illumination.

The spectroscope to which the apparatus is fitted has two fixed flint glass prisms, the refracting angle of each being 60° . This instrument is shown in the annexed engraving. When in use the prisms are covered by a brass cap provided with openings for the collimating and observing telescopes. The movable arm, D, that supports the observing telescope, also carries a vernier, which is moved with the telescope over a graduated arc, and in this usual way the relative positions of the several lines of a given spectrum can be determined. The angular distance traversed in passing from the extreme red to extreme violet is necessarily small, owing to the low dispersive power of the instrument, but this, I need scarcely say, is an advantage rather than the reverse in a spectroscope, which is commonly employed as an aid in ordinary qualitative analysis.

The graduations of the arc are unavoidably close, and difficult to read in a feeble light, consequently the eyes of the observer become speedily tired and unfitted for the examination of faint spectra. Nevertheless, measurements made with the graduated arc and vernier are, in my experience, more trustworthy and satisfactory than those obtained with even the best photographed scale that I have had the opportunity of working with. Desiring, then, to retain the method of direct angular measurement, I sought to multiply the motion in such a manner as to obtain wide readings on a convenient scale. After many trials in different directions, the form of apparatus which I shall now describe was finally adopted:

Description of the Apparatus.—The annexed woodcut, which is taken from a photograph, represents the whole apparatus. The index, A, attached to the spectroscope, moves in front of a graduated plate of opal glass, the latter being supported in the manner shown by the stand, S, to which the spectroscope is also screwed by means of the rod, R. The index is attached to a milled head which moves stiffly on a stout steel rod, r. The latter can revolve in little bearings supported by the projecting arm of "angle brass," a, the other end of the rod being let into a hole drilled in the head of the pillar, P, of the instrument. On the rod just mentioned, and immediately beneath e, a small toothed wheel is securely keyed. The diameter of this wheel is about

one centimeter, and the teeth upon it are fine and well cut. e is a stout metallic strip, five centimeters long, whose lower edge is serrated so as to correspond accurately with the teeth of the wheel on the rod, r, and to act upon the teeth directly, so as to cause the rod carrying the index, A, to rotate easily. This strip is bent to a curve whose radius is equal to the distance from the axis of the pillar, P, of the instrument to the middle of the toothed wheel. The strip is attached to a stout arm, and this is in turn screwed to the slightly projecting end of the heavy plate, D, which carries, and of course moves with, the observing telescope, the motion being communicated to the latter by turning the milled head, m. As the observing telescope moves over the graduated arc, g, the index, A, moves in front of the graduated plate, B, but in the opposite direction, for the motion of D is communicated to the rod, r, by means of the serrated slip, e. When the fittings are well made, the movement of the index, A, is steady, and corresponds in both directions with those of D.



MEASURING APPARATUS FOR A LABORATORY SPECTROSCOPE.

By the simple means described, a very slight motion of the observing telescope produces a comparatively considerable displacement of the index, A.

In my instrument, the telescope and the index move in opposite directions. Any objection on this score can be removed, for it is only necessary to point out that the motions may be made to coincide in direction by placing e under instead of over the toothed wheel.

Graduation of the Glass Plate.—It is very desirable that the graduations on the plate and on the arc of the instrument should agree. The best mode of securing this is to graduate the plate with the aid of the arc. For this purpose the telescope is moved into such a position that the rays less refrangible than the red potassium line shall occupy the field of view; the zero of the vernier is then made to coincide with the nearest convenient degree marked on the arc. The rod, r, is then firmly grasped, and the index, A, brought down to a horizontal position, and a fine dot made on the plate under the point by means of a pen dipped in "black japan." This point is taken as the zero of the scale. Each half degree is marked off in a similar manner until the semicircle is graduated. The two scales are again compared at different points, and the opal glass plate removed; each large division, corresponding to half a degree, is then subdivided into 10° equal parts. Finally, the semicircle is numbered from zero up to 200; each division of the scale, therefore, corresponds to $3'$ of the arc, g. In my spectroscope the angular motion of the observing telescope is magnified 25 times, and the width of each division of the glass scale is $2\frac{1}{2}$ millimeters, so that the readings are easily made in a feeble light without straining the eyes of the observer.

Reading off Positions of Spectral Lines.—In commencing an observation, it is always desirable to see that the point of the index, A, stands at the zero of the glass scale when the telescope is in the corresponding position on its scale. Any adjustment of the index that may be necessary is easily made in the way already described, namely, by firmly holding the rod, r, and turning the milled head which carries the index to the desired extent. The actual reading of the position of a line to which the point of the fine needle in the eyepiece is brought is then made from the glass scale.

An exceedingly feeble light suffices to enable the operator to read the wide divisions on the white scale; but in observing very faint lines I do not read by reflected light, but faintly illuminate the scale by means of a very small gas jet or lamp placed behind it. Sufficient light is transmitted by the opal glass to enable the readings to be easily and quickly made, while the eye of the operator is retained in a sensitive condition for feeble rays. Moreover, in reading it is not necessary to move the head away from the eyepiece of the instrument.

I have tried with success a mode of determining small differences with this apparatus which could doubtless be applied with advantage in mapping spectra with instruments of high dispersive power.

The glass plate, B, was removed from its stand, and the index from the rod, r. I then attached to the latter a cork carrying a small mirror placed at a suitable angle. A spot of light was reflected from this mirror, and made to fall on a screen placed several meters away. The relative distances between the members of groups of closely ruled lines (those of the nitrogen spectrum) were then easily determined in this manner, as the actual motion of the needle from point to point was greatly magnified.

The relative positions and widths of the lines seen with the instrument are easily laid down on a millimetric scale. I have had a number of 200 m.m. scales printed on narrow slips of paper, and the graduations are lithographed on a band of six equidistant lines, which thus serve for marking off intensities, according to Bunsen's graphic method. One millimeter corresponds to one unit of the scale on the opal glass screen, and consequently to three minutes as read off with the vernier on the graduated arc of the instrument. Differences corresponding to 1 can, therefore, be easily estimated and represented on the millimetric scale.

But one other practical point need be mentioned. I find it exceedingly convenient to mark off on the opal glass scale the positions of the more important lines of the elements whose spectra are easily obtained with the aid of the Bunsen flame. The symbol of the element to which a particular line or band belongs is legibly written under the particular point of the scale, and connected by a line with the point

in question. Identification of the bright lines observed in the spectrum of an unknown compound is thus greatly facilitated.—*Chemical News.*

ON THE COOLING OF FATS.

By MR. JOHN TREHARNE, M.B., C.M.

IF equal bulks of the fats of mutton, beef, pork, and butter, and palm oil be heated to 100°C . in a small flask fitted with a thermometer through the cork, and are then allowed to cool by radiation under the same conditions for each, the temperature is found to fall regularly to a certain point (which is different for each of the fats above named), and then to rise to a certain turning point. These turning points are approximately as follows:

For mutton fat	40.0°C .
" beef "	28.5 "
" pork "	26.5 "
" butter "	23.5 "
" palm oil	21.0 "

The extent of the rise in temperature is different in each fat, being greatest in that of mutton, and least in that of butter and palm oil. The extent of the rise is also greater within certain limits the greater the quantity of fat employed; but, as a rule, the turning point is pretty constant for the same fat. There is also a little difference in the turning point and the extent of rise according to the part of the carcass from which the fat has been taken.

If temperature and time be taken as co-ordinates and the rate of cooling be represented by curves, these latter will be characteristic of the respective fats. A mixture of equal parts of mutton and butter fats does not give a curve intermediate between those of its components, but is such as to indicate that less heat is given out in cooling (to 20°C ., say) than in the case of butter, which, compared with mutton fat, gives off very little heat.

POLYATOMIC ALCOHOLS.

By D. KLEIN.

IF borax and mannite be mixed in such proportions that less than $\frac{1}{2}$ equiv. of borax is taken to each equiv. of mannite, the liquid is acid. If $\frac{1}{2}$ equiv. of borax is employed, the liquid is neutral, but on treating the mixture with alcohol there remains a peculiar compound, the same as that produced on mixing the two substances equivalent for equivalent. The alcohol removes the excess of organic matter. If borax is added in excess it crystallizes, and the organic matter remains merely in combination with 1 equiv. of borax. If an aqueous solution of borax is poured into a concentrated solution of any of the following polyatomic alcohols—glycerine, erythrite, mannite, levulose, dextrose, and galactose (a and b), the polyatomic alcohol being in excess—an energetic acid reaction is immediately set up. The liquid turns blue litmus, the yellowish red shade characteristic of the more powerful acids, and the mixture attacks calcic and barytic carbonates. If the liquid is diluted with water, the blue color of the litmus is restored. If any of the above alcohols is added to a dilute aqueous solution of boric acid, too weak to redden blue litmus paper, an acid reaction is also developed, even if a solution containing merely 1:20000 of boric acid is brought in contact with mannite. With quercite, no similar reaction was obtained. The alkaline earthy bborates yield similar results to borax.

* The stand is of stout walnut wood. A rebate of the thickness of the glass plate is cut to the depth of three centimeters from the vertical piece of the stand. The straight edge of the plate is laid in the groove and is there secured, in part by a pin passing from behind through a hole drilled in the glass, and in part by a wooden slip screwed on in front.

* In the woodcut only five subdivisions are shown.

COLORED CRYSTALLINE COMPOUNDS OBTAINED FROM BRUCINE.

By DAVID LINDO.

It has long been known that deoxidizing agents, such as protochloride of tin and sulphide of ammonium, when added to a heated mixture of brucine and nitric acid, give rise to a deep violet coloration. On one occasion, having used sulphurous acid as the reducing agent to produce this effect, the tube containing the mixture was left at rest for some hours, when, on examination, it was found that a few violet-colored crystals had subsided. This substance is the nitrate of a blue-colored base, which is very unstable, absorbing oxygen from the air the moment it is liberated from its salts.

There is no difficulty in obtaining the nitrate in considerable quantities. I heat brucine with a moderate quantity of concentrated colorless nitric acid, add a little water, boil until the color changes to yellow, then add a strong solution of sulphurous acid in excess. A mass of violet-colored crystals, in the form of minute needles, separates as the solution cools. They are thrown on a filter, washed first slightly with water, then with alcohol, and dried on the water-bath. A yellow crystalline compound (the nitrate of another base) is also easily obtained from brucine by the action of nitric acid. It is probable this substance has been already described by Strecker, under the name of Cacothe-line. In order to obtain it, I act on brucine with nitric acid, as above, let the mixture cool a little, then add a considerable volume of alcohol. The yellow compound immediately separates in the form of minute crystals. It is washed with alcohol and dried on the water-bath. These two colored compounds are readily converted into each other by the addition or abstraction of oxygen.

The violet salt dissolves sparingly in cold, more freely in hot water, to a solution of the same color. It is insoluble in alcohol. If the aqueous solution is exposed to the air it gradually absorbs oxygen, and is converted, after some hours, into the yellow compound which remains in solution. Powerful oxidizing agents produce this change at once. The addition of sulphureted hydrogen, sulphide of ammonium, or other deoxidizers restores the violet color. If sulphurous acid is employed for the purpose it is generally necessary to apply heat. If a small quantity of the violet crystals is placed in a porcelain basin and treated with a few drops of strong solution of potash or soda, the base is released, and dissolves in the alkali with the production of a magnificent and intense blue color, which, however, quickly changes to yellow; the two colors mixing produce a beautiful green. The reaction is very delicate. The yellow salt is sparingly soluble in cold water, more freely in hot water. The solution is of a bright amber color. It is insoluble in alcohol. The addition of sulphureted hydrogen to the aqueous solution immediately converts it into the violet salt.

Other reducing agents, of course, produce the same result.—*Chemical News.*

A MANGANESE BLUE.

By M. GASTON BONG.

This blue is obtained on igniting silica, and any compound of manganese, with baryta, or a mixture of soda and lime in an oxidizing atmosphere. Either of the following mixtures may be used:

Silica..... 3	or Silica or kaolin..... 3	or 2
Soda-ash..... 6	Barium nitrate..... 8	
Carb. of lime (free from iron)..... 5	Oxide of manganese (free from iron)..... 3	

The proportion of manganese affects the intensity of the blue, but not its tone. By increasing the proportion of alkali or silica, a green or a violet tone is produced. The use of potassa does not give good results. The ignition should be effected at a red heat in the absence of reducing gases. These facts lead to a very delicate process for detecting the presence of manganese, especially in earthy substances. If to one of the above mixtures, made of materials free from manganese, any substance containing a trace of that element is added, a blue color appears on ignition.

ACTION OF OXYGEN UPON THE ANATOMIC ELEMENTS.—P. BERT.—The injurious influence of oxygen upon air-breathing vertebrates begins to be manifested at 5 or 6 atmospheres. The analysis of the gases contained in the blood shows that at this tension, the coloring matter of the blood-globules being completely saturated with oxygen, this gas begins to dissolve in the plasma. If the duration of the compression is prolonged the solution of oxygen in the tissues becomes general, when a diminution of organic oxidation appears with its most immediate consequence, a fall of the temperature of the body.

LACTIC FERMENTATION OF MILK-SUGAR.—CH. RICHET.—If milk is placed in a stove heated to 40° it becomes acid, coagulates, and after a time acquires an acidity of 1-6 of lactic acid in 100 parts of milk. This limit is never exceeded. If a few drops of a mineral acid are added to fresh milk the fermentation is completely checked and no further acidity is developed. But if, instead of a mineral acid, we add acid gastric juice, the lactic fermentation is developed with extraordinary rapidity, and the milk reaches in four or five days an acidity equal to 4 per cent. of lactic acid. The fermentation is arrested in presence of a large quantity of phenol, but unless there is sufficient of this reagent to remain in part undissolved in the liquid the fermentation is merely delayed.

CARBURATION OF NICKEL BY THE CEMENTATION PROCESS.

By M. BOUSSINGAULT.

NICKEL, like iron, is magnetic, sufficiently ductile to be forged and drawn into slender wire. Its point of fusion is very high, and if melted in a *brasqu* crucible it yields a homogeneous regulus of a silvery whiteness, containing carbon. The author has examined whether nickel, like iron, when carburated is capable of being tempered and acquires elasticity, and whether it renders steel less susceptible of oxidation. The result was decidedly negative, except that alloys of iron or steel, with large proportions of nickel, 30 per cent. and upward, resist the oxidizing action of air and water.

PREPARATION OF METHYL ALLYL.—H. GROSHENTZ.—The author heats to 135° in an autoclave a mixture of 40 parts zinc-methyl, 120 iodide of allyl, and 100 of an alloy of zinc and sodium at 3 per cent.—*Bulletin de la Société Chimique de Paris.*

STRAW FOR FODDER.

By PROFESSOR G. C. CALDWELL.

EVERY plant or part of a plant that is used for fodder is valuable for this purpose, because it is palatable to animals, so that they will eat it of their own free will and accord; and, in the second place, because it contains the three kinds of vegetable organic substance, albuminoids, fat and carbohydrates, such as starch, sugar and cellulose, in digestible forms. It is true that animals cannot dispense with the mineral part of the fodder, consisting of phosphates, chlorides, etc., but the quantity of these matters required is very small as compared with what is needed of organic substance, and only in rare cases is there any deficiency with respect to any of them except salt. Of these three kinds of organic substance, the one mentioned first is generally regarded as the most valuable; at least such is the view entertained everywhere in Germany; and if we duly consider the great amount of investigation of the subject of the feeding of stock that has been carried on there, the opinion is certainly entitled to much weight. The fats are ranked next to albuminoids, and last of all come the carbohydrates. There are some good reasons, therefore, for valuing that foddering material most highly which, other things about equal, is richest in albuminoids; clover as compared with timothy contains about 3 per cent. more of albuminoids, about the same proportion of fat, and about 3 per cent. less of carbohydrates; the greater richness in albuminoids justifies the estimation in which it is held as a richer foddering material than timothy. For a similar reason oat straw is worth more than wheat straw; the latter is worth less than timothy hay, partly because less palatable, but much more because it contains less than one-third as much albuminoids.

But the mere proportion of any constituent that is present in any article of fodder is not all that must be taken into account in making up the estimate of its value, or in comparing it with another kind of fodder. In the case of many of the ordinary foddering materials, a certain portion of each constituent is indigestible, and therefore quite worthless; the coarser and cruder the fodder, the larger the proportion of indigestible matter, as a general rule. The German investigations on the digestibility of fodder, which have now been carried on for so many years, have served to confirm many of the teachings of experience, as well as to add much to our positive knowledge in regard to this important subject. Some of the results of these investigations show in a striking manner the difference in nourishing value of the different cereal straws, owing to differences in the digestibility of their constituents, as set forth in the following table. In the first column of figures is given the number of pounds of albuminoids supplied, and in the second column the number of pounds of digestible albuminoids in a ton of the fodder; meadow hay is included in the list as furnishing a very suitable standard of comparison:

	Total albuminoids.	Digestible albuminoids.
Meadow hay.....	200	119
Wheat straw.....	60	15.5
Rye straw.....	72	17.4
Oat straw.....	91	39

It is seen that all the straws are greatly inferior to meadow hay in respect to the total albuminoids, but the inferiority is much greater when the comparison refers to digestible albuminoids; thus, in the ton of oat straw we have nearly half as much albuminous substance as in the meadow hay, but there is only a third as much digestible albuminous substance. On the other hand the superiority of oat straw over wheat or rye becomes more apparent when the digestibility of their constituents is compared. In the ton of oat straw we provide only a third more of albuminoids than in wheat, but of digestible substance of the same kind two and one-half times as much. In respect to the digestible fat the superiority of oat straw over wheat is no less marked, and as to the carbohydrates, also, when oat and rye straw are compared; but the carbohydrates of oat and wheat straw differ but little in digestibility. As one very interesting result of these considerations it appears that the maximum quantity of digestible albuminoids, fat, or carbohydrates in a ton of oat straw exceeds the minimum quantity of these substances in a ton of meadow hay; or, in other words, *oat straw may be better than meadow hay under some circumstances*, as shown in the following table, giving the pounds of digestible albuminoids to the ton of fodder in the two cases:

	Albuminoids.	Fat.	Carbohydrates.
Best oat straw.....	60	27	441
Poor hay.....	54	2	294

The quality of straw for fodder appears to vary with the character of the season, especially during the period of the formation and ripening of the grain. In this period comparatively little food is taken up by the plant, and the heads are matured at the expense of materials already accumulated in the stem and leaves; if the weather is unfavorable at this time—too cold, wet, or dry—the withdrawal of substance from the other parts of the plant for the formation of seed may be hindered, and the crop of grain will be poor, while, as a compensation for this loss, the straw will make much better fodder. For instance, in the wet and cold season of 1851, in Germany, oat straw contained 4½ per cent. of albuminous matters—only about the average proportion, it is true. But in the following year, when there was a dry season, and a better yield of grain, the straw contained but 2 per cent. of albuminoids. In 1868 the complaint was very general in certain localities of the poor quality of the oat-straw fodder, and an analysis of several samples showed that it contained only about 1.7 per cent. of albuminoids; there was evident good reason for finding fault with the fodder. That a well-fed crop makes fodder of better quality than a poorly-fed crop has been established by the results of many experiments, and the principle is in full accord with the results of experience; a plant that is well manured is richer in nitrogenous matters in every part than one grown on poor soil. In one case, where oats were cut just as the heads were formed, the crop from a rich soil contained two and a half times as much nitrogenous matter as the crop from a poor, unmanured soil; a well-fed barley crop contained one-third more nitrogenous matter than did a poorly-fed one; a well-fed clover crop one-fourth more, and so on.

The value of straw of any kind for fodder is greatly increased, according to the results of some analyses made by Voelcker eight years ago, by subjecting it to a slight fermentation. In Volume VI. of the Journal of the Royal Agricultural Society, Mr. Samuel Jonas describes a method of fermenting straw, which he had found to yield a fodder of excellent quality. The straw is cut as it comes from the threshing, and well trodden down in the part of the barn destined for its storage, while some green rye, also cut into chaff, is sown over it by hand, about one cwt. of the green material being added to a ton of the dry straw; a bushel of salt is also mixed with every ton of the fodder. As the re-

sult of this intimate mixture of the green with the dry material a slight fermentation sets in, the hard stems are softened down, and a pleasant flavor is communicated to the whole mass, which is scarcely inferior to that of prime meadow hay. A part of the results of Voelcker's analysis of this fermented fodder and of a sample of well-harvested wheat straw are given in the following table:

	Fermented straw.	Unfermented.
Water.....	7.8	13.3
Fat.....	1.6	1.7
Nitrogenous matters.....	4.2	2.9
Carbohydrates.....	10.2	4.3
Digestible fiber.....	35.7	19.4

The proportion of three important constituents is considerably increased, and the increase in digestible fiber is also useful, for, as far as this substance is digested, it is probably quite as useful in the animal economy as the sugar or starch. The straw is made richer in nitrogenous substance, not by the production of new nitrogenous substance, for this is impossible outside of the living plant, but partly because of the loss of water, and partly because of the decomposition of other constituents of the fodder by the fermentation; there is simply a concentration with respect to the nitrogenous matters, just as we may strengthen a solution of salt by driving out a part of the water by evaporation. A similar result follows it will be remembered by those who read the article on "Fermented Fodder" in a former number of *The Tribune* when green fodder is closely packed in pits, and allowed to ferment. In one such case, green corn fodder that contained nine pounds of carbohydrates to one of albuminoids had only seven pounds of the former to one of the latter after it had been in the pit or silo three or four months.

Mr. E. W. Stewart says that the cereal straw produced in this country is worth \$40,000,000. A prominent member of the Elmira Farmers' Club estimates that five tons of good straw fed with one ton of corn meal is equal to six tons of prime hay. Such estimates as these indicate the extent of the wastefulness when the farmer neglects to make proper use of this foddering material. It is comparatively poor in nitrogenous matters, even in its best condition, and, of course, animals cannot be profitably fed on it alone. It must be supplemented with clover, grain, or oil-cake, and it should be fed to young stock, rather than to cows in milk or to fattening animals. By the exercise of a little more wisdom and prudence in the management of our foddering material resources, a larger proportion might easily be utilized of the immense quantity of this material at our disposal, so much of which is now carried from the fields to the barn, only to be trodden under foot in the yard and mostly wasted, since it adds but little to the value of the manure.—*N. Y. Tribune.*

THE PLEASANT ART OF GRAFTING.

THERE is not one among all the processes of agriculture that is capable of yielding so rich a return for a trifle of trouble as the grafting of a wild tree with a fruitful and enjoyable variety. One minute will suffice for the grafting of the top of a young seedling, and this minute's work will effect a change of its whole nature, and of all its produce, throughout the ten, twenty, or fifty years of its future growth and fruitage. Every boy should learn to graft. It is one of the simple, useful, practical, and everywhere practicable things that should be part of common school instruction. The writer once knew some young women who could pare and set a graft or bud neatly, and with entire success, and who took pride and pleasure in practicing the art. Grafting will probably be attended with more than usual success this spring, because of the mildness of the winter, leaving the wood unharmed for those who did not exercise, at an earlier date, forethought enough to cut and store the scions. Young practitioners may find some hints useful, and here are a few, in addition to the excellent ones given last month by Mr. Smedley:

Choose sound, firm, ripe shoots, grown in full light, for the scions, and let them be entirely dormant when cut and set. With the cherry and plum it is indispensable to graft before the buds swell in the least; apple and pear will do much later, but all make more growth from the graft, and fewer wild shoots below and around it, if set quite early. The risk with early grafting is from dry March winds parching the graft, while it as yet receives little moisture from the scarcely started ascending flow of watery sap. This is prevented by using sound scions, by protecting them with a film of wax or a fillet of paper, and by using thicker wax and tying it in place so that it cannot become in the least detached, to admit desiccating air. A temperature of 50° to 60°, and dry weather, are most favorable for the operation. The wax should be made of such a temper as to work nicely at that temperature; not so soft as to be very sticky, nor so hard as not to stick or not to manipulate well. It should handle like rather tough putty in the temperature of ordinary spring water. There must be no free grease or oil to stop or enter the pores of the bark.

Whip or splice grafting is the most convenient and the safest. It is practiced on small shoots of the size of a large or small lead-pencil. The wax is then applied from a roll of strips of half-worn muslin soaked in it while melted by moderate heat. A piece is taken long enough for each graft; a strip ½ to ¾ inch wide and 2 to 3 inches long, wrapped on spirally, will completely cover and secure the joined parts. A good small knife, the roll of waxed cloth and the scions are all that need be carried. But a few strings, a hone or fine whetstone, and a register for entering the names, etc., should be part of the outfit.—*N. Y. Tribune.*

LAYING DOWN RASPBERRIES.—There is no doubt that all raspberries which are slightly injured by our severest winters, as well as the more tender ones, are benefited by winter protection. They start with more freshness and vigor when uncovered in early spring, and they bear better. *The Rural Home* says that the largest yield which the editor ever saw of the Franconia (which is often injured by winter in our latitude) followed the laying down the canes their entire length and covering with stable manure, and no other sort which we ever knew gave such a crop.

CULTIVATION OF SUGAR-BEETS.—A. LADUREAU.—A hectare of good land without manure gave 48,000 kilos. roots with 10-80 per cent. of sugar in the juice; manured with the drainage of dung-hills, 61,500 kilos., with 10-25 per cent. Soda salt-peter brought the percentage of sugar down to 8-36, earthen cake to 9-61, and complete chemical manure to 10-67. The chemical manure was very useful in destroying insects.

SCIENTIFIC AMERICAN CHESS RECORD.

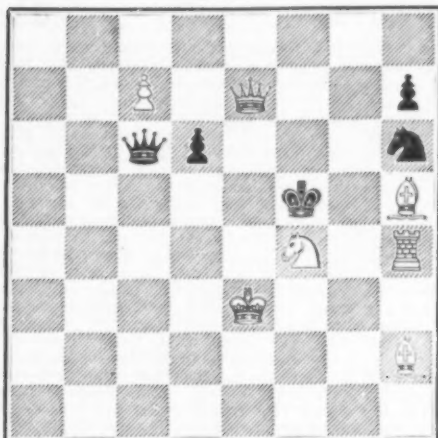
[All contributions intended for this department may be addressed to SAMUEL LOYD, Elizabeth, N. J.]

PROBLEM NO. 76.

BY SAMUEL LOYD.

First Prize in the American Union Problem Tournament of 1859.

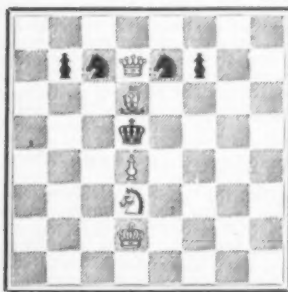
Black.



White.

White to play and mate in three moves.

GEORGE H. MACKENZIE.



White to play and mate in 3 moves.

By J. B. Muxon, of New York.

HE "Captain," as he is familiarly called, is as well known the entire (chess) world over, where he has a host of friends and admirers, and his chess achievements are so familiar to all, that it would be but a repetition to recount them, and we do not care to give a condensed and imperfect record of victories with which our readers are more familiar than ourselves; nor does it seem particularly appropriate to dwell at any great length upon one who requires no introduction, or to "write up"

on a champion just in the prime of his strength, and only entering, as it were, on a career in which we expect still greater things. Mr. Mackenzie—as his name implies—is of Scotch birth, although we first hear of him in London, as a player of considerable prominence. He has made New York his home now for many years, where by his charming manners and scholarly attainments he has gained a host of admirers, and has been so invariably successful in all matches and tournaments that our players seem to take a pride in yielding him the palm of superiority.

We have already given a record of the Chicago Chess Congress, in which he carried off the highest honors, as well as in that of Cleveland, an account of which we present this week, as well as an selected game from his remarkable match with Mr. Reichhelm, of Philadelphia.

He is a great admirer of problems, and is well posted on the prominent compositions of the leading composers, and shows great skill and good taste in solving and selecting the positions for the *Turf, Field, and Farm*, which under his able management has long been the leading authority on American chess.

We believe he has only essayed a few compositions of his own, although we were surprised to find the following in the *American Chess Nuts*:

ENIGMA NO. — BY G. H. MACKENZIE.

White.—K on Q Kt 5, R Q R 8, B K Kt 8, Kt Q B 4, Ps Q 4, K 5, K Kt 6 and K R 4.

Black.—K K 2, Bs K R 3 and 4, Ps Q 2, K 3, K B 3, K Kt 2 and 5.

White to play and mate in four moves.

For the portrait, which our readers will recognize as a most faithful likeness, we are indebted to the *American Chess Journal*, to which he has become attached as a regular contributor. We are pleased to learn that there is a prospect of his taking part in the Paris Tournament, in which case his admirers will have their wishes realized of seeing him measure lances with the best players that the old world can produce.

THE AMERICAN UNION PROBLEM TOURNAMENT, 1859.

THIS interesting little competition was inaugurated by Mr. J. A. Potter, in the chess department of the Boston *American Union*. Two prizes were offered for the best single problem—competitors allowed to enter as many problems as they pleased. Both prizes were awarded to Mr. Loyd, who had entered the second problem under the *nomme de plume* of W. King, that as well as B. Queen, W. K. Bishop, of Sacramento, A. Knight, of Castleton, Vt., being favorite names under which he had competed in quite a number of tournaments. We present the winning problems, which will doubtless be new to many of our solvers, No. 76 being slightly changed from the original version, which had a few surplus pieces.

THE SECOND AMERICAN CHESS CONGRESS.

THIS meeting was held at Cleveland, Dec. 5-15, 1871; each player was to contest two games with every other player; moves to be made at the rate of twelve to the hour.

Entrance fee \$10. There was also a problem tournament in connection with the meeting, an account of which was given in SUPPLEMENT No. 118.

The following list of names shows the number of participants as well as the order in which the prizes were awarded:

George H. Mackenzie, of New York: First Prize. \$100
Henry Hosmer, Chicago: Second Prize 50
Frederic Elder, Detroit: Third Prize 40
Max Judd, Cleveland: Fourth Prize 35
P. Ware, Boston: Fifth Prize 30
H. D. Smith, Cassopolis: Sixth Prize 20
Henry Harding, East Saginaw: Seventh Prize. 15
A. Johnston, Cincinnati.
W. B. Houghton, Chicago.

The following may be said to be the decisive game between Mackenzie and Hosmer, the winners of first and second prizes. The same players also received similar prizes in the third meeting, held at Chicago:

(Ruy Lopez.)

MACKENZIE.

HOSMER.

WHITE.

BLACK.

1. P to K 4
2. Kt to K B 3
3. B to Q Kt 5
4. B to Q R 4
5. P to Q 4
6. Castles.
7. P to K 5
8. Kt x Q P
9. Q x Kt
10. B to Q Kt 3
11. Q R P x Kt
12. P x P
13. Q x Kt P
14. R to K sq ch
15. B to K Kt 5 and wica.

1. P to K 4
2. Kt to Q B 3
3. P to Q R 3
4. Kt to K B 3
5. K P x Q P
6. B to K 2
7. Kt to K 5
8. Kt x Kt
9. Kt to Q B 4
10. Kt x B
11. P to Q 3
12. Q x P
13. B to K B 3
14. K to Q sq



GEORGE H. MACKENZIE.

MACKENZIE AND REICHHELM.

THE following is the concluding game in this remarkable match, played at Philadelphia, 1867, in which, it will be remembered, Mackenzie won seven games and drew two without a single defeat:

MACKENZIE.

REICHHELM.

WHITE.

BLACK.

1. P to K 4
2. Kt to K B 3
3. B to Q Kt 5
4. B to Q R 4
5. Castles.
6. Kt to Q B 3
7. B to Q Kt 3
8. P to K R 3
9. P to Q 3
10. Q R P x Kt
11. Kt x Q Kt P
12. Kt to Q B 3
13. Kt to K R 2
14. P to Q 4
15. P x P
16. Q to K 3
17. R to Q R 5
18. B to K 3
19. R to Q R 4
20. K R to Q sq
21. Q to K R 5
22. B x Kt P
23. Q x Kt P ch
24. Kt to K Kt 4
25. P x B
26. Q to K B 5 ch
27. R x Kt
28. Q R to Q B 4
29. P to K Kt 5, and Reichhelm resigned the game and the match.

1. P to K 4
2. Kt to Q B 3
3. P to Q R 3
4. B to K 2
5. Kt to K B 3
6. P to Q Kt 4
7. P to Q 3
8. Kt to Q R 4
9. Kt x B
10. P to K R 3
11. B to K 3
12. Q to Q 2
13. P to K Kt 4
14. P to Q B 3
15. P x P
16. Q to Q Kt 2
17. B to Q 3
18. B to Q B 2
19. Kt to Q 2
20. Castles K R
21. K to Kt 2
22. P x B
23. K to R 2
24. B x Kt
25. B to Q sq
26. K to Kt 2
27. Q to Q Kt sq
28. Q to Q B sq

Remove White's K Kt.

CAPT. MACKENZIE.

MR. X.

WHITE.

BLACK.

1. P to K 4
2. B to B 4
3. P to Q 4
4. P x P
5. Castles.

1. P to K 4
2. Kt to K B 3
3. Kt x P
4. Kt x P
5. Kt x Q

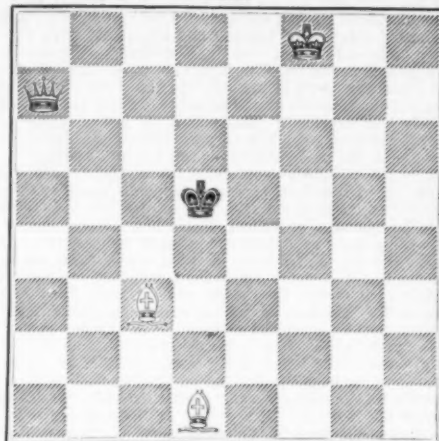
and White mates in two moves.

PROBLEM NO. 77.

BY SAMUEL LOYD.

Second Prize in the American Union Problem Tournament, 1859.

Black.



White.

White to play and mate in three moves.

SOLUTIONS TO PROBLEMS.

No. 70.—BY CONRAD BAYER.

WHITE.

BLACK.

1. B to K B 7
2. Kt to Q B 3
3. Kt to Q 5 mate.

1. R x B
2. K x Kt

2. B to B 3 ch
3. Kt to B 5 mate.

1. K x Kt
2. K to Q 5

2. Kt to Q 5 dis ch
3. Q to B 4 mate.

1. Q to R 6
2. K x Kt

2. Kt to B 5 ch
3. Kt to K Kt 3 mate.

1. Q to Q 7
2. K x Kt

No. 71.—BY SIGNOR J. PLACHUTTA, of Venice.

WHITE.

BLACK.

1. Q to K 8
2. Kt to K 4
3. Q to K 6 ch
4. P mates.

1. B to Q B 4
2. P x Kt
3. K x Kt

2. Q to B 8 ch
3. Kt x Q P ch
4. P mates.

1. K to B 4
2. K to Kt
3. K x Kt

2. Q to B 6 ch
3. Kt x R P
4. Kt mates.

1. Kt to K B 5
2. B covers
3. Any move

LETTER "R"—BY LOUIS QUIEN.

WHITE.

BLACK.

1. B to K 4
2. R or Kt mates.

1. Any move

ENIGMA NO. 38.—BY C. H. WATERBURY.

WHITE.

BLACK.

1. Q to K B 4 ch
2. Kt to Q B 4
3. R to B 3 mate.

1. K x Q
2. K moves

2. R to K Kt 3
3. Q to K 5 mate.

1. K to Q 4
2. K x Kt

EDGAR A. POE never could acquire proficiency in the game of chess, and therefore preferred draughts. "I will take occasion," he said, "to assert that the higher powers of the reflective intellect are more decidedly and more usefully taxed by the unostentatious game of draughts than by all the elaborate frivolity of chess." He wrote quite an ingenious article to prove what Harwitz called "his singular and strangely mistaken opinion."

THAT the method of deciding the first move was the same two centuries ago as that which is usually adopted now is shown by the title-page of Barbier's edition of Saul's "Famous Game of Chess Play," published in 1640. The lower half of the page is occupied by a cut representing two men with the chess board between them. The men are arranged in the order of battle, but a white and black pawn are wanting. One of the combatants is holding up his closed hand, and saying:

"If on your man you light,
The first draught shall you play;
If not, 'tis mine by right
At first to lead the way."

Draught, it will be remembered, signifies, in old English, move.

THE following (fabulous) legend of the origin of chess may be interesting to any of our readers to whom it is new:

At the commencement of the fifth century of the Christian era there lived in the Indies a very powerful prince, whose kingdom was situated near the mouth of the Ganges. He took to himself the proud title of the King of the Indies. Forgetting that the love of the subjects for their monarch is the only solid support of his throne, he swayed the land with such unnatural severity that the people, unable to longer bear such oppression, were preparing to throw off the yoke. A Brahmin, named Sissa, touched with the misfortunes of his country, resolved to make the prince open his eyes to the fatal tendency of his conduct, and invented the game of chess, wherein the king, although the most considerable of all the pieces, is both impotent to attack or defend himself against his enemies, without the assistance of his subjects. The prince, discerning the moral, wisely resolved to adopt a better course.

